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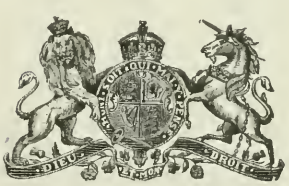
OF THE

DOMINION OF CANADA

SESSION 1910



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CONTENTS OF VOLUME 1.

(This volume is bound in two parts.)

1. Report of the Auditor General for the year ended 31st March, 1909. Volume I, Parts A, C to J (inclusive) L, M, N; Volume III, Parts V, W, X, Y. Presented 12th November, 1909, by Hon. W. S. Fielding. Volume II, Ports B, K and O to U, (inclusive), presented 12th January, 1910, by Hon. W. S. Fielding.

Printed for both distribution and sessional papers.

CONTENTS OF VOLUME 2.

2. Public Accounts of Canada, for the fiscal year ended 31st March, 1909. Presented 12th November, 1909, by Hon. W. S. Fielding.

Printed for both distribution and sessional papers.

3. Estimates of the sums required for the services of Canada for the year ending on the 31st March, 1911. Presented 18th November, 1909, by Hon. W. S. Fielding.

Printed for both distribution and sessional papers.

4. Supplementary Estimates of sums required for the service of Canada, for the fiscal year ending 31st March, 1910. Presented 24th November, 1909, by Hon. W. S. Fielding.

Printed for both distribution and sessional papers.

5. Further Supplementary Estimates of sums required for the service of Canada, for the fiscal year ending 31st March, 1910. Presented 14th March, 1910, by Hon W. S. Fielding.

Printed for both distribution and sessional papers.

5*a*. Supplementary Estimates of sums required for the service of Canada for the fiscal year ending 31st March, 1911. Presented 3rd February, 1910, by Hon. W. S. Fielding.

Printed for both distribution and sessional papers.

5*b*. Further Supplementary Estimates of the sums required for the service of Canada, for the fiscal year ending 31st March, 1911. Presented 30th April, 1910, by Hon. W. S. Fielding.

Printed for both distribution and sessional papers.

5*c*. Further Supplementary Estimates of the sums required for the service of Canada, for the fiscal year ending 31st March, 1910. Presented 20th April, 1910, by Hon. W. S. Fielding.

Printed for both distribution and sessional papers.

CONTENTS OF VOLUME 2—*Continued.*

6. List of Shareholders in the Chartered Banks of Canada, as on the 31st December, 1909. Presented 21st March, 1910, by Sir Wilfrid Laurier.

Printed for both distribution and sessional papers.

CONTENTS OF VOLUME 3.

7. Report of dividends remaining unpaid, unclaimed balances and unpaid drafts and bills of exchange in Chartered Banks of Canada, for five years and upwards, prior to 31st December, 1909.

Printed for both distribution and sessional papers.

CONTENTS OF VOLUME 4.

8. Report of the Superintendent of Insurance for the year ended 31st December, 1909.

Printed for both distribution and sessional papers.

9. Abstract of Statements of Insurance Companies in Canada, for the year ended 31st December, 1909.

Printed for both distribution and sessional papers.

CONTENTS OF VOLUME 5.

10. Report of the Department of Trade and Commerce, for the fiscal year ended 31st March, 1909. Part I.—Canadian Trade. Presented 12th November, 1909, by Hon. W. S. Fielding.. .. ..*Printed for both distribution and sessional papers.*

10*a*. Report of the Department of Trade and Commerce. Part II.—Canadian Trade with France, Germany, United Kingdom and United States. Presented 12th November, 1909, by Hon. W. S. Fielding.. .. .. ..*Printed for both distribution and sessional papers.*

10*b*. Report of the Department of Trade and Commerce for the fiscal year ended 31st March, 1909. Part III.—Canadian Trade with foreign countries except France, Germany, United Kingdom and United States. Presented 29th November, 1909, by Sir Wilfrid Laurier.. .. ..*Printed for both distribution and sessional papers.*

CONTENTS OF VOLUME 6.

10*c*. Report of the Department of Trade and Commerce for the fiscal year ended 31st March, 1909. Part IV.—Canadian Trade: Miscellaneous. Presented 12th November, 1909, by Hon. W. S. Fielding.. .. ..*Printed for both distribution and sessional papers.*

10*d*. Report of the Department of Trade and Commerce for the fiscal year ended 31st March, 1909. Part V.—Grain Statistics, including the crop year ended 31st August, 1909, and season of navigation ended 10th December, 1909. Presented 18th March, 1910, by Hon. W. S. Fielding.. .. ..*Printed for both distribution and sessional papers.*

10*e*. Report of the Department of Trade and Commerce for the fiscal year ended 31st March, 1909. Part VI.—Subsidized Steamship Services, with statistics showing steamship traffic to 31st December, 1909, and estimates for fiscal year 1910-1911. Presented 3rd May, 1910, by Sir Wilfrid Laurier..*Printed for both distribution and sessional papers.*

10*f*. Report of the Department of Trade and Commerce for the fiscal year ended 31st March, 1909. Part VII.—Trade of Foreign Countries and Treaties and Conventions. Presented 25th April, 1910, by Sir Wilfrid Laurier.

Printed for both distribution and sessional papers.

CONTENTS OF VOLUME 6—*Continued.*

10*g*. Certified copy of a Report of the Committee of the Privy Council, approved by His Excellency the Governor General on the 14th February, 1910, in respect to trade relations with Germany. Presented 15th February, 1910, by Hon. W. S. Fielding.
Printed for sessional papers.

10*h*. Trade relations with Germaney.—No. 2. Presented 2nd March, 1910, by Hon. W. S. Fielding.. .. .. .

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19. Report of the Minister of Public Works, for the fiscal year ended 31st March, 1909. Presented 12th November, 1909, by Hon. W. Pugsley.
Printed for both distribution and sessional papers.

19*a*. (No issue.)

19*b*. (No issue.)

19*c*. Supplementary Report of the International Waterways Commission, 1909. Presented 19th November, 1909, by Hon. W. Pugsley.
Printed for both distribution and sessional papers.

19*d*. Report of the International Waterways Commission on proposed dam and regulation work at foot of Lake Erie, and appendices accompanying said report. Presented 17th February, 1910, by Hon. W. Pugsley.. .. ..*Not printed.*

19*e*. Additional correspondence, International Waterways Treaty, and Report on division of Waters of St. Mary and Milk River. Presented 4th April, 1910, by Sir Wilfrid Laurier.
Printed for both distribution and sessional papers.

20. Report of the Department of Railways and Canals, for the fiscal year ended 31st March, 1909. Presented 12th November, 1909, by Hon. G. P. Graham.
Printed for both distribution and sessional papers.

CONTENTS OF VOLUME 11.

20*a*. Canal Statistics for the season of navigation, 1909. Presented 21st March, 1910, by Hon. G. P. Graham.. .. ..*Printed for both distribution and sessional papers.*

20*b*. Railway Statistics of Canada, for the year ended 30th June, 1909. Presented 12th January, 1010, by Hon. G. P. Graham.
Printed for both distribution and sessional papers.

20*c*. Fourth Report of the Board of Railway Commissioners for Canada, to 31st March, 1908, for the year ending 31st March, 1909. Presented 12th November, 1909, by Hon. G. P. Graham.. .. ..*Printed for both distribution and sessional papers.*

20*d*. Report of the Hudson Bay Railway Surveys. Presented 13th December, 1909, by Hon. G. P. Graham.. .. ..*Printed for both distribution and sessional papers.*

21. Report of the Department of Marine and Fisheries (Marine) for 1908. Presented 15th November, 1909, by Hon. L. P. Brodeur.
Printed for both distribution and sessional papers.

CONTENTS OF VOLUME 12.

21*a*. Eighth Report of the Geographic Board of Canada, containing all decisions to June 30, 1909. Presented 25th November, 1909, by Hon. L. P. Brodeur.
Printed for both distribution and sessional papers.

21*b*. List of Shipping issued by the Department of Marine and Fisheries, being a list of vessels on the registry books of Canada on the 31st December, 1909.
Printed for both distribution and sessional papers.

22. Report of the Department of Marine and Fisheries (Fisheries) for 1909. Presented 12th November, 1909, by Hon. S. A. Fisher.
Printed for both distribution and sessional papers.

CONTENTS OF VOLUME 13.

22*a*. Lobster Fishery. Evidence taken before Commander William Wakeham, M.D., (Officer in charge of the Gulf Fisheries Division) in Quebec and the Maritime Provinces. Two volumes. Presented 11th March, 1910, by Hon. W. Templeman. Also copy of the Report of Commander Wakeham in relation thereto.
Printed for both distribution and sessional papers.

CONTENTS OF VOLUME 14.

23. Report of the Harbour Commissioners, &c., to 31st December, 1908. Presented 13th January, 1910, by Hon. R. Lemieux..*Printed for both distribution and sessional papers.*

23*a*. Report of the Chairman of the Board of Steamboat Inspection, for the fiscal year ended 31st March, 1909. Presented 12th November, 1909, by Hon. S. A. Fisher.
Printed for both distribution and sessional papers.

24. Report of the Postmaster General, for the fiscal year ended 31st March, 1909. Presented 12th November, 1909, by Sir Wilfrid Laurier.
Printed for both distribution and sessional papers.

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25. Report of the Department of the Interior, for the fiscal year ended 31st March, 1909. Presented 12th November, 1909, by Hon. F. Oliver.
Printed for both distribution and sessional papers.

25*a*. Report of the Chief Astronomer.
Printed for both distribution and sessional papers.

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25*b*. Annual Report of the Topographical Surveys Branch.
Printed for both distribution and sessional papers.

25*c*. Report of the High Commissioner for Canada, for the year ended 31st March, 1909. Presented 12th November, 1909, by. Hon. F. Oliver.
Printed for both distribution and sessional papers.

26. Summary Report of the Geological Survey Branch of the Department of Mines, for the calendar year 1909.
Printed for both distribution and sessional papers.

26*a*. Summary Report of the Mines Branch of the Department of Mines.
Printed for both distribution and sessional papers.

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27. Report of the Department of Indian Affairs, for the fiscal year ended 31st March, 1909. Presented 12th November, 1909, by Hon. F. Oliver.
Printed for both distribution and sessional papers.

28. Report of the Royal Northwest Mounted Police, 1909. Presented 12th January, 1910, by Sir Wilfrid Laurier.. .. ..*Printed for both distribution and sessional papers.*

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29. Report of the Secretary of State of Canada for the year ended March 31, 1909. Presented 25th November, 1909, by Hon. C. Murphy.
Printed for both distribution and sessional papers.

29*a*. Report of the Imperial Conference with representatives of the self-governing Dominions on the Naval and Military Defence of the Empire, 1909. Presented 17th November, 1909, by Sir Frederick Borden. Also with additional papers relating to Australia and New Zealand, presented 10th December, 1909, by Hon. L. P. Brodeur.
Printed for both distribution and sessional papers.

29*b*. Report of the Department of External Affairs, 1909.
Printed for both distribution and sessional papers.

30. Civil Service List of Canada, 1909. Presented 12th January, 1910, by Hon. C. Murphy.
Printed for both distribution and sessional papers.

31. First Annual Report of the Civil Service Commission of Canada, for the period from September 1st, 1908, to August 31, 1909. Presented 10th December, 1909, by Hon. C. Murphy.
Printed for both distribution and sessional papers.

32. Annual Report of the Department of Public Printing and Stationery, for the fiscal year ended 31st March, 1909. Presented 18th April, 1910, by Hon. C. Murphy.
Printed for both distribution and sessional papers.

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33. Report of the Joint Librarians of Parliament for the year 1908-9. Presented 11th November, 1909, by the Hon. the Speaker.. .. ..*Printed for sessional papers.*

34. Report of the Minister of Justice as to Penitentiaries of Canada, for the fiscal year ended 31st March, 1909. Presented 12th November, 1909, by Hon. A. B. Aylesworth.
Printed for both distribution and sessional papers.

35. Report of the Militia Council, for the fiscal year ended 31st March, 1909. Presented 1st December, 1909, by Sir Frederick Borden.
Printed for both distribution and sessional papers.

35*a*. Interim Report of the Militia Council for the Dominion of Canada on the Training of the Militia during the season of 1909. Presented 25th April, 1910, by Sir Frederick Borden.. .. .. *Printed for distribution.*

36. Report of the Department of Labour, for the fiscal year ended 31st March, 1909. Presented 12th March, 1909, by Hon. L. M. King.
Printed for both distribution and sessional papers.

36*a*. Report of the Deputy Minister of Labour on industrial conditions in the Coal Fields of Nova Scotia. Presented 25th November, 1909, by Hon. L. M. King.
Printed for both distribution and sessional papers.

37. Fifth Report of the Commissioners of the Transcontinental Railway, for the year ended 31st March, 1909. Presented 12th November, 1909, by Hon. G. P. Graham.
Printed for both distribution and sessional papers.

38. Statement of Governor General's Warrants issued since the last session of parliament on account of the fiscal year 1909-10. Presented 15th November, 1909, by Hon. W. S. Fielding.. .. ..*Not printed.*

CONTENTS OF VOLUME 19—*Continued.*

39. Statement in pursuance of section 17 of the Civil Service Insurance Act, for the year ended 31st March, 1909. Presented 16th November, 1909, by Hon. W. S. Fielding. *Not printed.*

40. Statement of expenditure on account of miscellaneous unforeseen expenses, from the 1st April, 1909, to the 10th November, 1909, in accordance with the Appropriation Act of 1909. Presented 16th Novewber, 1909, by Hon. W. S. Fielding.. .. .. ..*Not printed.*

41. Statement of superannuation and retiring allowances in the Civil Service during the year ended 31st December, 1909, showing name, rank, salary, service, allowance and cause of retirement of each person superannuated or retired, also whether vacancy filled by promotion or by new appointment, and salary of any new appointee. Presented 16th November, 1909, by Hon. W. S. Fielding.. .. ..*Not printed.*

42. Return of constables employed on the Transcontinental Railway, as required under the provisions of section 6, chapter 92, of the Revised Statutes of Canada. Presented 19th November, by Hon. A. B. Aylesworth.. .. ..*Not printed.*

42*a*. Return to an order of the House of Commons, dated 16th November, 1909, for a copy of all reports, letters, communications and documents touching or relating to the resignation of Hugh D. Lumsden from his position as Chief Engineer of the National Transcontinental Railway, including a copy of all letters, communications or reports of the said Hugh D. Lumsden to the Prime Minister, touching or relating to his resignation, or to the affairs of the National Transcontinental Railway. Presented 23rd November, 1909.—*Mr. Borden.. ... ..Printed for both distribution and sessional papers.*

42*b*. Return to an order of the House of Commons, dated 29th November, 1909, for a copy of all correspondence had between the Minister of Railways and the Transcontinental Railway Commission relating to the sub-letting of contracts for the construction of the Transcontinental Railway in New Brunswick; and the failure of sub-constractors to make payment for supplies and material furnished by farmers, merchants and others for use in said work. Presented 13th December, 1909.—*Mr. Crocket.. ..Not printed.*

42*c*. Return to an order of the House of Commons, dated 29th November, 1909, for a copy of all correspondence connected with and relating to the letter of the Auditor General to the Secretary of the National Transcontinental Railway Commission of the 18th of August, 1909, in which the Auditor General points out that 64,192 cubic yards of excavation, classified at an average price of 83·06 cents, were subsequently reclassified at $1.10¼ per cubic yard, thereby increasing the cost by the sum of $17,453.80, and asking for an explanation. Presented 13th December, 1909.—*Mr. Lennox.. .. ..Not printed.*

42*d*. Return to an order of the House of Commons, dated 17th December, 1909, for a copy of all certificates, recommendations, letters, memoranda and documents in connection with the promotion of Mr. McIntosh on the 16th of November, 1908, from the position of Division Engineer, Division No. 6, District F, to the position of Assistant District Engineer, District F, and the increase of his salary from $200 to $275 per month; also of all complaints against the professional conduct or efficiency of Mr. McIntosh made to the Transcontinental Railway or the Railway Department before the date of promotion. Presented 24th January, 1910.—*Mr. Lennox.. .. ..Not printed.*

42*e*. Return to an order of the House of Commons, dated 29th November, 1909, for a copy of all correspondence between the following legal firms: Rothwell & Johnson, Rothwell, Johnson & Bergeman, and Rothwell, Johnson & Stubbs, on the one side, and the Government or the Transcontinental Railway Commissioners, on the other side, as to the instructions to the solicitors for legal services rendered in passing titles of property

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acquired by the Government, and in respect to the bill of cost and charges of the said several firms; and all papers, documents, letters, telegrams and correspondence having any reference to the items of charges of said firms appearing on page W—370 of the Auditor General's Report of 1909, amounting in the whole to $1,376.60. Presented 24th January, 1910.—*Mr. Meighen*.. .. ..*Not printed.*

42*f*. Return to an order of the House of Commons, dated 17th December, 1909: 1. Showing the names and addresses of the engineers who surveyed and located the line of the Eastern Division of the Transcontinental Railway, and the part of the railway covered by the work of each engineer. 2. The name and address of the engineer who prepared the estimates of quantities and prices of the section or portion of the line covered by each contract. 3. The names of the engineers acting upon behalf of the Railway Department, or Railway Commission, and the Grand Trunk Pacific Railway Company, in determining upon the form and wording of the specifications, as provided for by the seventh section of the agreement between the government and the company. 4. The names of such of the engineers acting in any of the capacities aforesaid, as subsequently acted in connection with construction, when and for how long, in what capacity, where their services have been dispensed with, and for what cause. 5. The names and addresses of all the engineers in the service of the Railway Commission, or Railway Department, on Districts B and F of the said Eastern Division, since the commencement of the construction of the railway, the capacity in which each was employed, the salary in each case, the promotions, increases of salary, retirements and dismissals which have taken place, the cause for promotion, dismissal or retirement in each case, and a copy of all complaints lodged with the commissioners or their chief engineer or the department, against any of these engineers. 6. The names of the engineers now in charge of or engaged upon District B and F, and the official position and salary of each. Presented 3rd February, 1910.—*Mr. Lennox*.. .. ..*Not printed.*

42*g*. Interim Report of the Commissioners of the Transcontinental Railway, being for the nine months ended 31st December, 1909, setting forth the receipts and expenditure in connection with the Eastern Division of the National Transcontinental Railway, and such other matters in relation to the said railway as appear to be of public interest. Presented 4th February, 1910, by Hon. G. P. Graham.. .. ..*Not printed.*

42*h*. Return to an order of the House of Commons, dated 7th February, 1910, showing all written objection to classification upon the Transcontinental Railway made since July 28th, 1908, and in reference to overbreak or other over expenditure since 2nd October, 1908. Presented 17th February, 1910.—*Mr. Lennox*.. .. ..*Not printed.*

42*i*. Return to an order of the House of Commons, dated 24th January, 1910, showing: (*a*) The names of the contractors for the construction of the National Transcontinental Railway and the number, mileage and location of the contract; (*b*) the estimated expenditure under each contract at the time the contract was let, based upon the engineer's estimate of quantities, at dates of the accepted tender; (*c*) the estimated increase or decrease in expenditure in each case occasioned by change in location, specification, construction, material, grade or other change subsequent to the letting of the contract; (*d*) the amount returned and claimed on progress estimates under each contract to date, the amount actually paid under each contract, and the estimated amount yet required to complete the work in each case; (*e*) the engineer's estimated quantity of solid rock, loose rock and common excavation in the section of line covered by each contract, the estimated cost under these headings, based upon the rates of the accepted tender, the actual expenditure under these headings to date, as shown by progress estimates, the amounts actually paid to date under these headings, and the

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estimated quantities of work yet to be done, and the estimated sums yet to be paid under these headings in respect of each contract. Also as to all contracts other than the twenty-one covered by the Return brought down on the 26th of April, 1909, No. 46h: a copy of (*a*) engineer's itemized estimate of quantities as to each contract of each class of work and material, as set out in the schedules and itemized, and total estimated expenditure based upon rates of accepted tender, and (*d*) a copy of all tenders received; (*c*) itemized quantities of work and material under the various headings actually done or furnished to date, and itemized, and total expenditure therefor; itemized statement of estimated quantities of work yet to be done and material, &c., yet to be furnished and itemized, and total estimated cost of the same based on contract prices. Presented 17th February, 1910.—*Mr. Lennox.*
Not printed.

42*j*. Return to an address of the House of Commons, dated 14th February, 1910, for a copy of all correspondence, submissions, references, reports, returns and orders in council, in reference to the adjustment of the disputed item of 581 cubic yards of excavation, claimed at 10 instead of $2.50 a cubic yard, referred to in a letter of the Auditor General to the Secretary of the Transcontinental Commission, dated the 18th August, 1909. Presented 24th February, 1910.—*Mr. Lennox*.. .. ..*Not printed.*

43. Report of Robert M. Coulter, Deputy Postmaster General, on his mission to Australia and New Zealand to discuss with the governments of those countries the possibility of taking steps that would lead to the inauguration of a steamship service between England, Australia and New Zealand, via Canada, on the Atlantic and Pacific oceans. Presented 22nd November, 1909, by Sir Wilfrid Laurier.. ..*Printed for sessional papers.*

44. Return to an order of the House of Commons, dated 16th November, 1909, for a copy of all correspondence, documents and papers of every description not already brought down touching the recent treaty with the French Republic, or any modification therein. Presented 24th November, 1909.—*Mr. Borden*.. .. ..*Not printed.*

45. Minutes of proceedings of the Board of Internal Economy of the House of Commons for the past year, pursuant to Rule of the House No. 9. Presented 24th November, 1909, by the Hon. The Speaker.. .. ..*Not printed.*

46. Detailed statement of all bonds or securities registered in the Department of the Secretary of State of Canada, since last return (2nd February, 1909), submitted to the parliament of Canada under section 32 of chapter 19, of the Revised Statutes of Canada, 1906. Presented 25th November, 1909, by Hon. C. Murphy.. .. ..*Not printed.*

47. Return under chapter 125 (R.S.C), 1906, intituled: 'An Act respecting Trade Unions,' submitted to parliament in accordance with section 33 of the said Act. Presented 25th November, 1909, by Hon. C. Murphy.. .. ..*Not printed.*

48. Return of orders in council passed between the 1st of December, 1908 and the 31st October, 1909, in accordance with the provisions of section 5 of the Dominion Land Survey Act, chapter 21, 7-8 Edward VII. Presented 29th November, 1909, by Hon. F. Oliver.. .. ..*Not printed.*

49. Return of orders in council which have been published in the *Canada Gazette* and in the *British Columbia Gazette*, between 1st December, 1908, and 31st October, 1909, in accordance with provisions of subsection (*d*) of section 38 of the regulations for the survey, administration, disposal and management of Dominion lands within the 40-mile railway belt in the province of British Columbia. Presented 29th November, 1909, by Hon. F. Oliver.. .. ..*Not printed.*

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50. Return of orders in council passed between the 1st December, 1908, and the 31st October, 1909, in accordance with the provisions of the Forest Reserve Act, sections 7 and 13 of chapter 56, Revised Statutes of Canada. Presented 29th November, 1909, by Hon. F. Oliver.. .. ..*Not printed.*

51. Return of orders in council passed between the 1st December, 1908, and the 31st October, 1909, in accordance with the provisions of the Rocky Mountain Park Act, section 5 of chapter 60, Revised Statutes of Canada. Presented 29th November, 1909, by Hon. F. Oliver.. .. ..*Not printed.*

52. Return of orders in Council which have been published in the *Canada Gazette*, between 1st December, 1908, and 31st October, 1909, in accordance with the provisions of section 77 of the Dominion Lands Act, chapter 20 of the Statutes of Canada, 1908. Presented 29th November, 1909, by Hon. F. Oliver.. .. ..*Not printed.*

53. Return to an order of the House of Commons, dated 18th November, 1909, for a copy of all correspondence and papers respecting the application by the United States immigration service to the Minister of the Interior, for the deportation of one Mrs. Goby, an alleged immigrant, to the United States of America from Canada, entering at the port of Sault Ste. Marie, Michigan, together with a copy of all orders, decisions, reports and returns regarding any action taken thereupon by the Department of the Interior. Presented 1st December, 1909.—*Mr. Boyce*.. .. ..*Not printed.*

54. General orders issued to the Militia between the 1st February, 1909, and the 1st November, 1909, inclusive. Presented 1st December, 1909, by Sir Frederirck Borden.
Not printed.

55. Report of the Ottawa Improvement Commission for the fiscal year ended 31st March, 1909. Presented 3rd December, 1909, by Hon. W. S. Fielding.
Printed for sessional papers.

56. Certified copy of a Report of the Committee of the Privy Council, approved by His Excellency the Governor General on the 12th May, 1909, on the subject of a despatch from the Right Honourable the Principal Secretary for the Colonies, transmitting an invitation from the Honorary Secretary of the 12th International Congress on Alcoholism to the Government of Canada, to appoint delegates to attend the congress in question. Presented 6th December, 1909, by Sir Wilfrid Laurier.. .. ..*Not printed.*

57. Return to an order of the House of Commons, dated 22nd November, 1909, for a copy of all memorials, reports, correspondence and documents in the possession of the government not already brought down, relating to a survey of a route for a tunnel under the Straits of Northumberland between the province of Prince Edward Island and the mainland of Canada, and also relating to the construction of such tunnel. Presented 6th December, 1909.—*Mr. Warburton*.. .. ..*Not printed.*

58. Return (in so far as the Department of the Interior is concerned) of copies of all orders in council, plans, papers, and correspondence which are required to be presented to the House of Commons, under a resolution passed on 20th February, 1882, since the date of the last return, under such resolution. Presented 7th December, 1909, by Hon. F. Oliver.. .. ..*Not printed.*

58*a*. Return of lands sold by the Canadian Pacific Railway during the year ended on the 31st October, 1909. Presented 18th January, 1910, by Hon. F. Oliver.. .. ..*Not printed.*

59. Return to an address of the House of Commons, dated 16th November, 1909, for a copy of all orders in council at present in force with reference to immigration; also a copy of all regulations in force at the present time in connection with immigration in Canada. Presented 9th December, 1909.—*Mr. Wilson (Lennox)*.. .. .. ..*Not printed.*

CONTENTS OF VOLUME 19—*Continued.*

60. Return to an order of the House of Commons, dated 22nd November, 1909, showing:— 1. The application made to the Railway Board for protection of railway crossings under the provisions of chapter 32 of the Statutes of 1909, an Act to amend the Railway Act, and (*a*) the cases in which these applications have been granted, (*b*) in which they have been refused, when refused, and the reason for refusal. 2. The names of the persons in each case making the application. 3. The cases in which the board of its own motion made an order for the protection of crossing under said act. 4. The appropriation made by the board out of the Railway Grade Crossing Fund under said act, and the crossing in respect of which such appropriations were made. 5. The character or description of the crossing in question, and the character, description and cost in each case of the construction work of protection ordered or directed by the board. 6. The amount in each case ordered or directed by the board to be paid out of the said fund and by the railway company and municipality or other party to the proceedings. 7. The cases in which the work ordered to be done (*a*) has been completed, (*b*) in which it is under construction, (*c*) the cases in which the municipality has submitted to or complied with the order of the board, and (*d*) cases in which the municipality has refused to comply. Presented 14th December, 1909.—*Mr. Lennox.*
Not printed.

61. Return to an order of the House of Commons, dated 24th November, 1909, showing what Indian lands within the territories now covered by each of the provinces of Manitoba, Saskatchewan and Alberta, have been sold yearly since 30th June, 1900; such information to be detailed as follows: the name of each reserve, the area sold therein yearly, the average prices realized, and the cash paid to the Indians concerned at the time of sale, under the terms of surrender. Presented 15th December, 1909.—*Mr. McGrath.*
Not printed.

62. Return to an order of the House of Commons, dated 22nd November, 1909, showing the areas sold or leased as oil lands in the Northwest, giving the amount sold or leased, the date when, and the parties to whom sold or leased, and if leased, the various assignments, if any, made thereof, and the dates of the same. Presented 15th December, 1909.—*Mr. Foster*.. .. ..*Not printed.*

63. Return to an order of the House of Commons, dated 16th November, 1909, showing: Copy of the contract for the dredging of the Napanee river during the summer of 1909; name of the contractor who had the contract; names of the engineers in charge of the work and the inspector; the depth and width of the channel after dredging; the length of time taken to complete the work; the total amount of money expended on the work; whether the work was done by day work or by the yard; and the prices paid by day or by yard. Presented 15th December, 1909.—*Mr. Wilson (Lennox).*
Not printed.

64. Return made to parliament in accordance with chapter 47, section 4, Revised Statutes, 1906, containing copy of the orders in council for the issue of licenses to United States fishing vessels to enable them to buy bait, ice, lines, &c. during the year 1910. Presented 16th December, 1909, by Hon. L. P. Brodeur.. .. ..*Not printed.*

65. Return, in pursuance of section 16 of the Government Annuities Act, 1908, containing statement of the business done during the fiscal year ending March 31st, 1909, together with a copy of the regulations made under section 13 of the act. Presented 17th December, 1909, by Hon. W. S. Fielding.. .. ..*Printed for sessional papers.*

66. Report of the Commissioner, Dominion Police Force, for the year 1909. Presented 12th January, 1910, by Hon. A. B. Aylesworth.. .. ..*Not printed.*

CONTENTS OF VOLUME 19—*Continued.*

67. Return to an order of the House of Commons, dated 29th November, 1909, for a copy of all reports and correspondence in connection with section 29, township 9, range 22, west of the 4th meridian, as well as applications for railway right of way and station grounds within such land. Presented 12th January, 1910.—*Mr. McGrath..Not printed.*

68. Return to an order of the House of Commons, dated 6th December, 1909, for a copy of all papers, reports, correspondence, &c., between the Department of the Interior and its officers and agencies and any other persons, relative to the s.w. ¼ section 24-38-10 w. 3rd m., and the respective claims of Allan R. Mudie and Thos. G. Warwick. Presented 12th January, 1910.—*Mr. Lake.. .. .. .

CONTENTS OF VOLUME 19—*Continued.*

75. Return to an order of the House of Commons, dated 17th December, 1909, for a copy of all papers, reports, correspondence, &c., between the Department of the Interior, and its officers and agencies, and any other person, relative to the s.w. ¼ section 16-30 9, w. 3rd m., and the respective claims thereto of Thomas Paterson and J. F. Sibbald. Presented 13th January, 1910.—*Mr. Lake*.. .. ..*Not printed.*

76. Return to an order of the House of Commons, dated 24th November, 1909, showing approximately the amount of revenue collected by the government between the 1st January, 1908, and the 1st November, 1909, in the province of Alberta and Saskatchewan, respectively, on account of payments for coal lands, coal royalties, bonuses and rental on timber lands, timber dues, hay lands, grazing lands, irrigation areas, school lands, minerals, water powers, stone quarrying lands, Indian lands, or on account of any natural resources within each of the above provinces. Presented 13th January, 1910.—*Mr. McCarthy*.. .. ..*Not printed.*

77. Return to an order of the House of Commons, dated 17th December, 1909, for a copy of all documents and papers relating to the western shipment of grain. Presented 13th January, 1910.—*Mr. Taylor (Leeds)*.. .. ..*Not printed.*

78. Return to an order of the House of Commons, dated 24th November, 1909, for a copy of all letters, correspondence and complaints, or other papers, from Indians or others regarding the manner in which the St. Peter's Indians have been treated relating to lands allotted to them by the government in consideration of the surrender of St. Peter's Reserve. Presented 13th January, 1910.—*Mr. Bradbury*.. .. .. ..*Not printed.*

78*a*. Return to an order of the House of Commons, dated 13th December, 1909, for a copy of all instructions to J. O. Lewis, Indian Agent at Selkirk, regarding the delivery of patents to Indians entitled to same, in connection with the surrender of St. Peter's Reserve. Presented 13th January, 1910.—*Mr. Bradbury*.. .. ..*Not printed.*

78*b*. Return to an order of the House of Commons, dated 6th December, 1909, showing all moneys paid by the government in connection with the surrender of St. Peter's Reserve, to whom paid, and for what; also all moneys paid in connection with the moving of the Indians to the new reserve on Lake Winnipeg, to whom paid, and for what. Presented 13th January, 1910.—*Mr. Bradbury*.. .. ..*Not printed.*

78*c*. Return to an order of the House of Commons, dated 29th November, 1909, for a copy of all instructions sent to the Indian Agent at Selkirk, in connection with St. Peter's Indians pledging or disposing of their holdings, secured through the surrender of their reserve; a statement showing all those entitled to receive patents for lands in connection with the surrender of the reserve, the applications made by those so entitled for their patents, and receipts signed for the patents by those so entitled on delivery of the patent. Presented 13th January, 1910.—*Mr. Bradbury*.. .. ..*Not printed.*

78*d*. Copy of papers relating to St. Peter's Indian Reserve, comprising letters of instructions and commission to Mr. H. M. Howell, Report of H. M. Howell, and advertisement in connection with auction sale of lands. Presented 27th January, 1910, by Hon. F. Oliver.. .. ..*Not printed.*

78*e*. Return to an order of the House of Commons, dated 17th January, 1910, for a copy of all accounts of George Tracy, of Selkirk, against Indians of St. Peter's Reserve, Manitoba, now on file in the Department of Indian Affairs here, and of all correspondence in the department in relation therto. Presented 31st January, 1910.—*Mr. Bradbury*.. .. ..*Not printed.*

CONTENTS OF VOLUME 19—*Continued.*

78*f*. Return to an order of the House of Commons, dated 14th February, 1910, for a copy of all papers and instructions given to A. S. Williams, Law Clerk of the Department of Indian Affairs, and to S. Swinford, Inspector of Indians, Winnipeg, in connection with their work among the St. Peter's Indians in Manitoba; also a copy of the report of these gentlemen in connection with the work they have been engaged in during the last few weeks among the St. Peter's Indians. Presented 4th April, 1910.—*Mr. Bradbury.*
Not printed.

79. Return to an order of the Senate, dated 26th November, 1909, for a copy of the several complaints which in 1908 and 1909 have been made by different parties to the Minister of the Interior or to the Superintendent of Immigration of the manner in which immigrants are treated at Quebec. Presented 13th January, 1910—*Hon. Mr. Landry.*
Not printed.

80. Return to an order of the Senate, dated 2nd December, 1909, for a copy of all accounts filed during the fiscal year 1907-8 in the Department of the Interior by Sosthène Morisset, one of the clerks of the Immigration office at Quebec. Presented 13th January, 1910.—*Hon. Mr. Landry*.. .. ..*Not printed.*

80*a*. Return to an order of the Senate, dated 3rd December, 1909, for a copy (1) of the medical certificate given by Doctors Pagé and Nadeau to justify the order for the sending back of the immigrant Otta Nittenen, in November, 1908; (2) of the correspondence on this subject exchanged between the agent of the Canadian Pacific Railway, Mr. Jules Hone, and Messrs. Lavoie and Stein of the Immigration Office at Quebec, and the Superintendent General of Immigration at Ottawa, Mr. W. D. Scott, in November and December, 1908. Presented 13th January, 1910.—*Hon. Mr. Landry.*
Not printed.

80*b*. Return to an order of the Senate, dated 3rd December, 1909, for a copy of the attendance and pay-lists of the employees in the Immigration Office at Quebec, for the first four months of the present year. Presented 13th January, 1910.—*Hon. Mr. Landry.*
Not printed.

80*c*. Return to an order of the Senate, dated 2nd December, 1909, for the Report of Detentions and Deportations at the port of Quebec for the month of November, 1908. Presented 13th January, 1910.—*Hon. Mr. Landry*.. .. ..*Not printed.*

80*d*. Return to an address of the Senate, dated 25th January, 1910, for a copy of the attendance and pay-lists of the employees of the Immigration Office at Quebec, for the months of January, February, March and April of 1909. Presented 10th February, 1910.—*Hon. Mr. Landry*.. .. ..*Not printed.*

80*e*. Return to an order of the Senate, dated 12th January, 1910, for a copy of the report made in 1906 to the Department of the Interior by Mr. Blair, upon the inquiry held by him at Quebec, at the Immigration Office, on the subject of certain complaints concerning the administration of the said office. Presented 22nd February, 1910.—*Hon. Mr. Landry*.. .. ..*Not printed.*

80*f*. Return to an order of the House of Commons, dated 13th December, 1909, for a copy of the correspondence exchanged since the 1st of January, 1908, between the medical examiners of immigrants and the Superintendent of Immigration, respecting the inspection of immigrants. Presented 23rd March, 1910—*Mr. Paquet*.. ..*Not printed.*

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80*g*. Return to an order of the Senate, dated 10th March, 1910, for the production of all complaints made to the Department of the Interior against the present Immigration Agent at Quebec, and of all the correspondence exchanged on this subject between the different parties in question and the department or any of its officers. Presented 6th April, 1910.—*Hon. Mr. Landry*.. .. .. .

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82. Return to an order of the House of Commons, dated 6th December, 1909, for a copy of all correspondence, reports, documents and papers touching the matter of the salmon fishery of Salmon River, Digby county, N.S., and the fishways or passes in said river. Presented 17th January, 1910.—*Mr. Jameson*.. .. ..*Not printed.*

83. Return to an order of the House of Commons, dated 22nd November, 1909, for a copy of all reports, correspondence and other papers relating to the condition and maintenance of the buoy on the Old Proprietor Ledge in the Bay of Fundy since January 1st, 1908; also of all reports, correspondence and other papers relating to the establishment, equipment, maintenance and operation of the life boat and life saving station at Seal Cove, in the Bay of Fundy; also copy of all instructions issued to Captain Lugar in connection with the inquiry into the wreck of the ss. *Hestia*, and of the findings and report on said inquiry. Presented 17th January, 1910.—*Mr. Daniel*.. .. ..*Not printed.*

83*a*. Supplementary Return to No. 83. Presented 14th February, 1910.. .. .. ..*Not printed.*

84. Return to an order of the House of Commons, dated 15th December, 1909, showing: 1. The present indebtedness to the Dominion government of the Montreal Turnpike Trust (*a*) on capital account, (*b*) for arrears of interest. 2. The amount collected at each toll gate belonging to the said turnpike trust during the year ending 31st December, 1908, and for the first six months of the year 1909. 3. The names of all parties who have commuted their tolls during each of the two above mentioned periods and the amount of the commutation money paid to the trust in each case. 4. The amount expended on each section or road division under the control of said trust, during the year ending 31st December 1908, and the contracts given out during the said year, with the name of the contractor and the date and amount of money involved in each case; and a statement in each case also as to whether the contract was awarded after tender called through newspapers. 5. The amount paid out during the said two first above-mentioned periods at each toll gate for salaries of day and night guardians and any other expenditures at each of the toll gates maintained. 6. The names of all parties holding passes for free use of the roads under control of said trust during the period above mentioned, with a statement, in each case, of the reason why the pass was so granted. 7. The expenses of the said trust during each of the two periods above mentioned for rent, salaries of the office, inside or outside service, giving name and remuneration of each official and amounts paid to any civil engineer employed by the trust. 8. The actual present indebtedness in detail of said trust outside of its bonds due to the government of Canada. 9. The amounts collected by said trust during the above-mentioned periods from municipalities under special agreements made as to their share pro rata of the bonded indebtedness of the turnpike trust. 10. The names of all members of the trust elected to represent the bondholders, with date of election in each case, during said two periods. 11. The amounts paid by the trust to any of its members or officials during said two periods, whether as travelling or personal expenses, or indemnity for attendance or for any other reason whatever. 12. The name of any auditor who has acted during said two periods, and the amount paid such auditor. 13. An exact statement of any amounts paid by the trust for purchase or lease of any property outside of the city of Montreal and in defraying the travelling or displacement or maintenance expenses of the trustees or their officials generally. Presented 17th January, 1910.—*Mr. Monk*.. .. ..*Not printed.*

85. Return to an address of the House of Commons, dated 29th November, 1909, for a copy of all orders in council relating to the North Atlantic Trading Company, and all correspondence between the North Atlantic Trading Company and the government, or any member or official thereof, since November 1, 1906, and up to 20th November, 1909. Presented 20th January, 1910.—*Mr. Wilson (Lennox)*.. .. ..*Not printed.*

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85*a*. Return to an order of the House of Commons, dated 15th December, 1909, for a copy of petition of right of pleas offered in defence in the case of the suit of the North Atlantic Trading Company vs. the King, in the Exchequer Court, and of all correspondence as well as reports and petitions which led up to the government granting a fiat to the suppliant; and a copy of all letters having reference to the said claim now sued upon from the time of the final payment to the said North Atlantic Company. Presented 20th January, 1910.—*Mr. Monk*.. .. ..*Not printed.*

86. Return to an order of the House of Commons, dated 6th December, 1909, for a copy of all correspondence, documents, and reports since the 1st January, 1908, between our immigration agents in Belgium and the Minister of the Interior. Presented 20th January, 1910.—*Mr. Paquet*.. .. ..*Not printed.*

86*a*. Return to an order of the House of Commons, dated 18th November, 1909, giving the names and addresses of all immigration agents at the present time employed by the government in Great Britain, the continent of Europe, and the United States, on salary, the amount of salary paid to each, the amount of other perquisites paid to each, if any; the names and addresses of all immigration agents at the present time employed by the government in the above countries on commission, the amount of such commission, the rate of commission per immigrant, the amount of other perquisites paid to each; the names and addresses of all special immigration agents in the above countries appointed during the fiscal years 1908-9 and up to 1st November, 1909, the date of the appointment of each, the address of each at the time of his appointment, the amount of salary, commission, or other perquisites paid to each, and the length of time served by each in respect of such appointment. Presented 4th February, 1910.—*Mr. Wilson (Lennox)*.. .. ..*Not printed.*

87. Return to an order of the House of Commons, dated 1st December, 1909, showing all casualties and accidents attended with danger or loss of human life, that have occurred in the Marine and Fisheries Department owing to the operation of pintsch and acetylene gas as an illuminant, for each year since 1880, together with a copy of all papers and reports in connection therewith. Presented 20th January, 1910.—*Mr. Foster.* *Not printed.*

88. Return to an order of the House of Commons, dated 6th December, 1909, for a copy of all correspondence, petitions, and other papers between any person or persons and the government, or any member thereof, or any official thereof, with reference to the dredging of the Napanee river. Presented 20th January, 1910.—*Mr. Wilson (Lennox).* *Not printed.*

89. Return to an order of the House of Commons, dated 13th December, 1909, for a copy of all correspondence had between the Post Office and Public Works Departments, together with all reports and other documents relating to the necessity of providing adequate post office accommodation in the city of Lethbridge. Presented 20th January, 1910.—*Mr. Magrath*.. .. ..*Not printed.*

89*a*. Supplementary Return to No. 89. Presented 18th February, 1910.. .. .. ..*Not printed.*

90. Interim Report of the Dominion Fisheries Commission for the investigation of the waters on Lac du Bonnet fisheries. Presented 20th January, 1910, by Sir Wilfrid Laurier.. .. ..*Not printed.*

90*a*. Interim Report of the Dominion Fisheries Commission for the investigation of the waters of Manitoba and the West. Presented 20th January, 1910, by Sir Wilfrid Laurier.. .. ..*Not printed.*

CONTENTS OF VOLUME 19—*Continued.*

90*b*. Return to an order of the House of Commons, dated 22nd November, 1909, for a copy of all letters, telegrams, applications, contracts, lease or leases and correspondence with regard to Lac du Bonnet fishing. Presented 27th January, 1910.—*Mr. Campbell.* *Not printed.*

90*c*. Return to an address of the House of Commons, dated 4th February, 1909, for a copy of all correspondence, orders in council, papers and documents relating to the question of fisheries in the Pembina river, in the province of Manitoba, and of regulations or agreements with the United States government in reference to the rivers running from one country into the other. Presented 14th February, 1910.—*Mr. Sharpe (Lisgar).* *Not printed.*

91. Return to an order of the House of Commons, dated 15th December, 1909, for a copy of the pay sheets of the employees on the Lachine canal under the supervision of Denis O'Brien for the months of May, June, July, August, September, October and November. Presented 24th January, 1910.—*Mr. Verville*.. .. ..*Not printed.*

92. Return to an order of the House of Commons, dated 24th January, 1910, for a copy of all instructions given during his term of office by the Honourable Speaker Blanchet, to the then sergeant-at-arms, or to other officials in connection with the appointment of sessional messengers. Presented 26th January, 1910.—*Mr. Monk*.. .. .. ..*Not printed.*

93. Return to an order of the House of Commons, dated 18th November, 1909, showing the number of fatal accidents resulting from the use of explosives in the construction of railways and other public works in Canada, reported to either the Department of Railways and Canals, the Department of Public Works, or the National Transcontinental Railway Commissioners, within the past three years; the nature of investigation, if held, after each accident; and what precautions have been taken to prevent or minimize the number of accidents from the use of explosives on construction work in Canada under control of governrment officials. Presented 26th January, 1910.—*Mr. Robb*.. .. ..*Printed for sessional papers.*

94. Return to an order of the House of Commons, dated 18th November, 1909, for a copy of all applications, petitions, letters, telegrams, documents, plans, specifications and correspondence with reference to, and in any way concerning the application for subsidy for the building of a dry-dock and ship-building yard by certain persons, or company, at or in the vicinity of the town of Sault Ste-Marie, Ontario. Presented 26th January, 1910.—*Mr. Boyce*.. .. ..*Not printed.*

94*a*. Return to an order of the House of Commons, dated 18th November, 1909, for a copy of all applications, petitions, letters, telegrams, documents, plans, specifications and correspondence with reference to and in any way concerning the application for subsidy for the building of a dry-dock and ship-building yard by certain persons, or company, at or in the vicinity of the town of Port Arthur, Ontario. Presented 11th March, 1910.—*Mr. Boyce*.. .. ..*Not printed.*

95. Return to an order of the House of Commons, dated 17th December, 1909, showing: 1. A description by sections, townships and ranges, with areas of all lands included in the area controlled by the Southern Alberta Land Company under agreements with the government, and the date of expiry of such agreements. 2. A description by sections, townships and ranges with areas of all lands held under grazing lease or leases or assignment of leases and now controlled by Messers. Cowdry & Maunsall, or either of them, of lands which lie between the Bow and Belly rivers, bounded on the east by range 12 and on the west by range 19, west of the fourth meridian. Presented 27th January, 1910.—*Mr. McCarthy*.. .. ..*Not printed.*

CONTENTS OF VOLUME 19—*Continued.*

96. Return to an order of the House of Commons, dated 17th January, 1910, showing: 1. What amount has been annually expended by the government since the year 1900 in connection with the Atlantic Fisheries of Canada, apart from sums spent in the fishery protection service and for bounty, in the respective provinces of Nova Scotia, New-Brunswick, Prince Edward Island and Quebec. 2. The amount expended in each of the said provinces annually for fishery breeding purposes, dog-fish reduction plants, bait freezers, cold storage and salaries of officials, respectively. 3. What other general purposes in connection with the fisheries expenditures were made in such provinces within said period. Presented 27th January, 1910.—*Mr. Jameson*.. .. .. ..*Not printed.*

97. Regulations of the National Parks of Canada. Presented 28th January, 1910, by Hon. F. Oliver.. .. ..*Printed for sessional papers.*

98. Return to an order of the House of Commons, dated 19th January, 1910, showing all tenders called for by the Department of Railways and Canals, or the purchasing agent of the Intercolonial Railway of Ottawa, at any time during the year 1909, for wire fencing; a copy of any tenders received for such fencing, with the names of the tenderers, and the prices quoted by the said parties tendering for the different kinds of fencing; the names of the successful tenderers, and the particular kind of fencing bought, the gauge of wire, number of stands and distances apart of the brackets in uprights; the price per rod, and where the wire was manufactured. Presented 1st February, 1910.—*Mr. Wilcox*.. .. ..*Not printed.*

98*a*. Return (in part) to an order of the House of Commons, dated 1st December, 1909, for a copy of all papers in connection with the alleged securing and sale or distribution of passes on the Intercolonial Railway within the last two years, and also of all papers of every kind in connection with the alleged padding of pay-lists on the Windsor Branch Railway, and the re-sale of mutilated railway ties to the government. Presented 16th February, 1910—*Mr. Foster*.. .. ..*Not printed.*

98*b*. Return to an order of the House of Commons, dated 24th January, 1910, showing: 1. How many derailments have taken place on the Intercolonial Railway during the year 1909. 2. At what points of the railway each of these derailments took place, and at what dates. 3. The report made in each case, and the cause or causes mentioned in such report. Presented 17th February, 1910.—*Mr. Talbot*.. .. ..*Not printed.*

98*c*. Return to an order of the House of Commons, dated 7th February, 1910, showing: Since the beginning of the autumn train service of 1909 on the Intercolonial Railway, at what time the train leaves Oxford Junction every week day morning for Pictou is due to leave Oxford Junction and arrive at Pictou; the actual time at which the train departed each day from Oxford Junction, the actual time at which it arrived each day at Pictou; the causes of the delay, if any; and what efforts are being made to improve the service in respect of time. Presented 24th February, 1910.—*Mr. Rhodes*.. .. ..*Not printed.*

98*d*. Return to an order of the Senate dated 15th February, 1910, for a statement showing in so many distinct columns: 1. The names of all the employees of the Intercolonial Railway who have been dismissed or who have resigned since the Intercolonial Railway was put under the direction of the Commission of that road. 2. The respective salaries of such employees. 3. The date of their appointment. 4. The date of their dismissal. 5. The number of the division or of the section of the railway where they were employed. 6. The domicile of such employees at the time of their dismissal. Presented 19th April, 1910.—*Hon. Mr. Landry*.. .. ..*Not printed.*

CONTENTS OF VOLUME 19—*Continued.*

98*e*. Return to an order of the House of Commons. dated 14th March, 1910, showing: Since the appointment of the Government Railways' Managing Board, how many employees of the Intercolonial Railway have been dismissed at Truro, at Halifax, and at Stellarton, respectively, with their respective names; at what kind of work each was employed; on what dates, respectively, each one was dismissed; how many of them since re-employed; on what dates, respectively, each one was re-employed; how long since such re-employment each one has remained in the service; how many of them are still in the service, with their names and what each one is employed at. Presented 20th April 1910.—*Mr. Rhodes*.. .. ..*Not printed.*

98*f*. Return to an order of the House of Commons, dated 22nd November, 1909, showing the number of passes issued on the Intercolonial Railway from October 1st, 1908, to October 1st, 1909, whether annual, return trip or trip, to whom issued, the authority and upon whose recommendation the passes were issued and reasons for the issue, the several points at which these passes took effect and the destination, and also a copy of the agreement entered into by the various railways of Canada regarding the non-issuing of passes. Presented 20th April, 1910.—*Mr. Stanfield*.. .. ..*Not printed.*

99. Return to an order of the House of Commons, dated 6th December, 1909, for a copy of all letters, communications, petitions and correspondence with and by the government, or any minister, with regard to the appointment of some one to fill the vacancy on the Board of Railway Commissioners, caused by the demise of the late Honourable Thos. Greenway. Presented 1st February, 1910.—*Mr. Campbell*.. .. .. ..*Not printed.*

100. Return to an address of the House of Commons, dated 29th November, 1909, for a copy of all memorials, reports, correspondence and documents in the possession of the government, relating to the reduction of the representation in the House of Commons, of the several provinces of Nova Scotia, New Brunswick and Prince Edward Island, and of all correspondence with the governments of these provinces with regard to the restoration to the said provinces of such representation as they respectively had at the time of their becoming provinces of this Dominion. Presented 1st February, 1910.—*Mr. Warburton*.. .. ..*Printed for sessional papers.*

101. Return to an order of the House of Commons, dated 19th January, 1910, for a copy of all declarations, affidavits and solemn declarations made and sent to the Post Office Department, or to the Honourable the Postmaster General, since the first day of September, 1907, up to the fifteenth day of January, 1910, respecting the franking privilege asked for the Arthabaska *Gazette*, with copies of the lists of pretended subscribers to that newspaper with the said declarations, affidavits and solemn declarations; also a copy of the report of Mr. A. Bolduc, Post Office Inspector, respecting the said Arthabaska *Gazette*. Presented 2nd February, 1910.—*Mr. Lavergne*.

Not printed.

102. Return to an order of the House of Commons, dated 13th December, 1909, showing a list of the free mail delivery routes which have been established in Canada, including the port of departure and the place of arrival, the length of each, the number of houses on each route, and the number of boxes on each route. Presented 3rd February, 1910.—*Mr. Armstrong*.. .. ..*Printed for sessional papers.*

102*a*. Return to an order of the House of Commons dated 6th December, 1909, for a copy of all papers, letters, telegrams, documents and correspondence with reference to or in any way concerning the installation of free mail delivery service in the city of Sydney, N.S. Presented 17th February, 1910.—*Mr. Maddin*.. .. ..*Not printed.*

CONTENTS OF VOLUME 19—*Continued.*

103. Return to an order of the House of Commons, dated 3rd February, 1910, for a copy of the report of Commander Wm. Wakeham, Special Commissioner and Inspector of Fisheries for the Gulf of St. Lawrence, on the Lobster Industry of the Maritime Provinces and the province of Quebec. Presented 3rd February, 1910, by Sir Wilfrid Laurier.. .. ..*See Sessional Paper No. 22a.*

104. Return to an order of the House of Commons, dated 17th January, 1910, for a copy of all correspondence, reports, despatches, documents and other papers relating in any way to the claim for a homestead, by the members of the family of Angus Sauve, who was in the African campaign, and who died a short time after his arrival in the country. Presented 4th February, 1910.—*Mr. Boyer.. .. ..Not printed.*

104*a*. (1909). 1. International Boundary Waters Treaty, signed at Washington, 11th January, 1909. 2. Rider attached by the United States Senate.
Printed for both distribution and sessional papers.

105. Report of a system of uniform and common international regulations for the protection and preservation of the food fishes in international boundary waters of Canada and the United States. Prepared by the International Fisheries Commission pursuant to and under the authority of the Convention of April 11, 1908, between Great Britain and the United States. Presented 4th February, 1910, by Sir Wilfrid Laurier.. .. ..*Printed for distribution.*

106. Return to an order of the House of Commons, dated 19th January, 1910, for a copy of all papers, letters, telegrams, documents and correspondence, occurring during the first six months of 1908, in connection with suggested amendments to the Northwest Irrigation Act. Presented 7th February, 1910.—*Mr. Magrath.. .. ..Not printed.*

107. Return to an address of the House of Commons, dated 16th November, 1909, for a copy of all petitions addressed to His Excellency the Governor General of Canada, or to the government, or any department thereof; also of all letters, correspondence of all kinds, and all reports had by the government in reference to the navigation, cleaning and deepening of the river known as River des Prairies, following along the northern boundary of the island of Montreal. Presented 7th February, 1910.—*Mr. Monk.*
Not printed.

107*a*. Report of Mr. G. de G. Languedoc, assistant engineer, in respect of work required to be done along Rivière des Prairies, to give a five-foot channel at low water for navigation. Presented 15th February, 1910, by Hon. W. Pugsley.. .. ..*Not printed.*

108. Return to an order of the House of Commons, dated 24th January, 1910, showing what interest or control the Canadian Northern Railway Company has in any of the following railway companies: The Ontario and Rainy River Railway Company, the Port Arthur, Duluth & Western Railway Company, the Manitoba & Southeastern Railway Company, the Minnesota & Manitoba Railway Company, the Minnesota & Ontario Bridge Company, the Saskatchewan Northwestern Railway Company, the Qu'Appelle, Long Lake & Saskatchewan Railway Company, the Alberta Midland Railway Company, the Edmonton, Yukon and Pacific Railway Company. 2. What subsidies either in land, money or by way of guarantee of securities have been granted to any of the railway companies mentioned on account of the main or branch lines or both, of the said companies, either by the Dominion government, or the provincial governments of Ontario, Manitoba, Saskatchewan and Alberta, or any municipality through which their lines run. 3. What portion of these subsidies have been earned to date. 4. How many miles west of Edmonton a line of railway is constructed and in operation

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by the Canadian Northern Railway Company. 5. What work other than location survey work has been done west of this point up to date, how much and of what nature. 6. What portion, if any, will eventually form part of the proposed line to Vancouver. 7. When the location plan of the route of the C.N.R. between Edmonton and Vancouver, by way of the Yellow Head Pass was approved by the Minister of Railways and the Board of Railway Commissioners. 8. What applications, if any, have been made since to change or in any way alter this location plan. 9. To what extent, if any, the government of Manitoba has exercised its right of control of freight rates under section 8 of schedule B of the Act 1 Edward VII, chapter 53. 10. What effect, if any, this section of said act has had in reducing freight rates in the province of Manitoba. Presented 8th February, 1910.—*Mr. Lennox*.. .. ..*Not printed.*

109. Return for the year ended 31st December, 1909, of permits to take intoxicants into the Northwest Territories, in accordance with the requirements of chapter 62, section 88, of the Revised Statutes of Canada. Presented 8th February, 1910, by Hon. F. Oliver.
Not printed.

110. Return to an order of the House of Commons, dated 6th December, 1909, showing how many officials of the government, or of the Senate or House of Commons, have residences or living rooms in Ottawa supplied by the Crown, with the estimated yearly value and the rent charged in each case. Presented 14th February, 1910.—*Mr. Blain.*
Not printed.

110*a*. Supplementary Return to No. 110. Presented 24th February, 1910... ...*Not printed.*

111. Return to an order of the Senate, dated 26th January, 1910, showing the total amount of lands set apart for school purposes in Rupert's Land, or what now comprises the provinces of Manitoba, Saskatchewan and Alberta. The amount of said lands sold for school purposes yearly before the formation of the provinces of Saskatchewan and Alberta, and the average price realized per acre for same. The amount sold yearly in all the said provinces up to the year 1910, and the average price realized for same. The total amount of acres of school lands yet remaining unsold in the said provinces. Presented 15th February, 1910.—*Hon. Mr. Davis*.. .. ..*Not printed.*

112. Return to an order of the House of Commons, dated 6th December, 1909, showing the amount received by the Minister of Finance under the Land Titles Act, section 159, cap. 110, R.S.C., 57 and 58 Vic., cap. 28, sec. 116; how such fund is invested under sec. 160 of the same Act; the amount of interest which has accrued from said fund; and the amount paid for losses arising from bad titles guaranteed by said fund. Presented 22nd February, 1910.—*Mr. Macdonell*.. .. ..*Not printed.*

113. Return to an order of the House of Commons, dated 17th January, 1910, showing: 1. The name, cost, date of construction, place of construction, and gross tonnage of each of the steam vessels now owned by the Dominion government. 2. The names of those built in Canada. 3. What ones thrown open to Canadian competition. 4. In each case that was open to Canadian competition, the difference between the lowest Canadian tender and the price paid. 5. In each case where a contract was made with a builder for the construction of any of said steam vessels, the month and day when each of said contracts were signed, and when each of said contracts called for delivery of vessels. 6. The price each of the said steam vessels would have cost if the government in each case paid the current Canadian customs duty chargeable on vessels constructed outside of Canada. Presented 24th February, 1910.—*Mr. Sinclair.*
Printed for sessional papers.

CONTENTS OF VOLUME 19—*Continued.*

114. Return to an order of the House of Commons, dated 15th March, 1909, showing: 1. The number and names of the various dredges owned by the government. .2 When and by whom constructed, or when and from whom purchased. 3. The price paid for each dredge. 4. On what work each dredge has been engaged in in each of the years 1905, 1906, 1907 and 1908. 5. How many months during each of these years each dredge was working, and how many cubic yards of material each dredge removed per month. 6. The cost of maintaining and cost of operating each dredge for each of these years. 7. The names of the dredges leased during these years, if any, to whom leased, on what terms, and what amounts were received each year under such leases. Presented 24th February, 1910.—*Mr. German*.. .. ..*Not printed.*

115. Return to an order of the House of Commons, dated 19th January, 1910, for a copy of all letters, telegrams, petitions and other correspondence in connection with the establishing of a post office to be named Charleston or Kelmont, on the south side of Assiniboine river, in the parish of St. Charles, province of Manitoba. Presented 24th February, 1910.—*Mr. Staples*.. .. ..*Not printed.*

116. Return to an order of the House of Commons, dated 7th February, 1910, for a copy of all correspondence between the District Officer Commanding Military District Number 11 and the Department of Militia, with reference to the battery of 12-pounder B.L. guns recently sent to Esquimalt, or with reference to the proposal that No. 1 Company of the 5th Regiment, C.A., should train on said guns. Presented 24th February, 1910.—*Mr. Barnard*.. .. ..*Not printed.*

117. Return to an order of the House of Commons, dated 7th February, 1910, showing the total cost to Canada of the Military College buildings and grounds, and the amount furnished each year by the government towards its maintenance. Presented 24th February, 1910.—*Mr. Armstrong*.. .. ..*Printed for sessional papers.*

118. Return to an order of the House of Commons, dated 7th February, 1910, for a copy of all papers, affidavits and correspondence between the Interior Department and John A. Dunn, or anyone in his behalf, and any official of the department, concerning the application for patent of the n.w. ¼ sec. 34, tp. 35, range 16, west of the 2nd meridian. Presented 24th February, 1910.—*Mr. Roche*.. .. ..*Not printed.*

119. Statement of the affairs of the British Canadian Loan and Investment Company (Limited), for the year ended 31st December, 1909. Also a list of the shareholders on 31st December, 1909, in accordance with chapter 57 of 39 Victoria. Presented (Senate) 25th February, by the Hon. the Speaker.. .. ..*Not printed.*

120. Return to an order of the Senate, dated 23rd November, 1909, for a copy of each charter granted since 1st June, 1909, by the Secretary of State, by letters patent under The Companies Act, chapter 79 of the Revised Statutes, 1906. (*a*) Incorporating any company with powers for the development, production, distribution or use of water power for any purposes; or with powers for the production, distribution and use of water power for any purposes; or with powers for the production, distribution and use of electricity in any form by any means, whether directly or by the transformation thereof into heat, light, power or any other kind of energy; or (*b*) conferring such powers upon any company previously incorporated. Presented 1st March, 1910.—*Hon. Mr. David*.. .. ..*Not printed.*

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121. Return to an order of the House of Commons, dated 14th February, 1910, showing the amounts that have been paid to the *Whig* Publishing Company for printing and advertising by or for any departments of this government other than Militia and Defence and Marine and Fisheries, each year, from 1896 to the present time. Presented 2nd March, 1910.—*Mr. Edwards*.. .. ..*Not printed.*

121*a*. Supplementary Return to No. 121. Presented 10th March, 1910.. .. .. ..*Not printed.*

122. Return to an order of the House of Commons, dated 29th November, 1909, for a copy of all letters, correspondence, papers, bills and memorials, passing between the government of the province of Manitoba and the Dominion government since 1st January, 1907. Presented 2nd March, 1910.—*Mr. Roche*.. .. ..*Not printed.*

122*a*. Return to an address of the House of Commons, dated 28th February, 1910, and also of the Senate, dated 24th February, 1910, for a copy of all correspondence between the Dominion government and the government of Manitoba on the subject of the extension of the boundaries of the province of Manitoba since the resolution adopted by the House of Commons on the 13th day of July, 1908. Presented 2nd March, 1910.—*Hon. Mr. Watson and Mr. Molloy*.. .. ..*Not printed.*

123. Return to an address of the Senate, dated 3rd February, 1910, for the production of all correspondence between the Honourable George E. Foster, M.P., and the government of Canada, or any of their members since the year 1878, in relation to appointment of judges to the judicial bench and of members to the Senate of Canada. Presented 6th April, 1910.—*Hon. Mr. Cloran*.. .. ..*Not printed.*

124. Return to an order of the House of Commons, dated 28th February, 1910, showing all sums of money received by the *Soleil* Publication Company, the *Vigie* Publication Company, and the *Daily Telegraph* Publication Company of Quebec, from the different federal departments, and from the Transcontinental Commission, since the first day of March, 1908, and the respective dates of each payment. Presented 3rd March, 1910.—*Mr. Paquet*.. .. ..*Not printed.*

125. Return to an order of the House of Commons, dated 29th November 1909, for a copy of all correspondence, reports, advertisements, tenders, contracts and other papers and documents relative to the maintenance of a wrecking plant on the Pacific or Atlantic coasts, or in the River or Gulf of St. Lawrence, not already brought down. Presented 3rd March, 1910.—*Mr. Taylor (Leeds)*.. .. ..*Not printed.*

126. Return to an order of the House of Commons, dated 19th January, 1910, showing how much money has been paid by this government in each year from 1896 to 1909, both years included, to the firms of Elliott Bros., and of R. Carson, of Kingston, Ontario, for supplies furnished to, or services of any kind performed by the government. Presented 4th March, 1910.—*Mr. Edwards*.. .. ..*Not printed.*

127. Return to an order of the House of Commons, dated 19th January, 1910, showing: 1. The amount of Canada's copper, silver, and gold coinage, respectively, for each of the last ten years, and the cost and profit of each year's coinage, counting the interest and depreciation of the cost of the Canadian Mint at 6 per cent, and the cost of maintenance and staff for the years during which it has been in operation. 2. The amount of United States silver, and at what cost that has been deported each year, and the estimated amount of United States silver current in Canada from year to year. Presented 4th March, 1910.—*Mr. Foster*.. .. ..*Not printed.*

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128. Return to an order of the House of Commons, dated 7th February, 1910, showing the number of chartered banks that have gone into liquidation since 1888, the date of the charters of each, the date of suspension, the capital stock, assets and liabilities, respectively, at date of supension, and the per cent of dividends paid to both holders and depositors respectively. Also what other banks have disappeared by amalgamation or otherwise, with similar information as above in respect to them. Presented 4th March, 1910.—*Mr. Foster*.. .. .. .

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134. Return to an order of the House of Commons, dated 17th February, 1909, showing particulars of the places where the expenditures mentioned in column 365, unrevised *Hansard,* for wharfs in Nova Scotia, New Brunswick and British Columbia, where made, together with amounts expended in each instance for construction and repairs, respectively. Presented 10th March, 1910.—*Mr. Barnard.. .. ..Not printed.*

135. Return to an address of the House of Commons, dated 16th November, 1909, for a copy of all petitions addressed to the government or any member thereof, as well as of all letters, correspondence and reports in the possession of the government, and having reference to repairs required at two wharfs built by the government and situated at Ste. Genevieve and Isle Bizard, in Jacques Cartier County, P.Q., and also all the correspondence concerning the construction of those wharfs, and of their use as piers for a bridge. Presented 11th March, 1910.—*Mr. Monk.. .. ..Not printed.*

136. Return to an order of the House of Commons, dated 17th January, 1910, showing the foreign exhibitions in which Canada has taken part since July, 1896, the time and place where such was held, the expenditure thereon by the government of Canada, the persons, not common labourers, who had charge of the same or were employed thereat, the sums paid to such severally under the heads of (*a*) salary, (*b*) expenses, and the total cost to the country of each such exhibition; also the amounts received as revenue from the sale of articles or commodities, lumber, buildings and other materials, respectively. The whole statement to be made up in tabular form and the additions of money columns to be made. Presented 11th March, 1910.—*Mr. Foster.*
Printed for sessional papers.

137. Return to an order of the Senate, dated 18th February, 1910, for a statement showing the number of homestead entries, pre-emptions, scrip locations and military warrant locations in townships 35, 36, 37, 38 and 39, in ranges 1 to 19, inclusive, of 4th meridian, and in townships 32, 33 and 34, in ranges 1 to 8 inclusive, west of 4th meridian. Presented 16th March, 1910.—*Hon. Mr. Talbot.. .. ..Not printed.*

138. Return to an order of the House of Commons, dated 19th January, 1910, for a copy of all correspondence between the government, or any member thereof, and the Imperial South African Service Association, or any of its officers, in reference to a proposed military reserve to be formed by the members of the Imperial South African Veterans' Association. Presented 17th March, 1910.—*Mr. Macdonald.. ..Not printed.*

139. Return to an address of the House of Commons, dated 14th February, 1910, for a copy of all orders in council, correspondence, reports, documents and papers, relating to the right or privilege to raise the waters of Clear Lake, province of Manitoba, application for which was made by a company to develop power on the Little Saskatchewan river. Presented 21st March, 1910.—*Mr. Roche.. .. ..Not printed.*

140. Return to an order of the House of Commons, dated 7th February, 1910, for a copy of all correspondence, advertisements, tenders and other documents, in connection with a proposal or proposals to lease a part or the whole of the Black Foot Reserve. Presented 21st March, 1910.—*Mr. Magrath.. .. ..Not printed.*

141. Return to an order of the House of Commons, dated 14th March, 1910, for a copy of all correspondence, reports, documents and papers relating to the strike of the employees of the Dominion Coal Company and the Cumberland Coal and Railway Company, in the counties of Cape Breton and Cumberland, Nova Scotia. Presented 23rd March, 1910.—*Mr. Rhodes.. .. ..Not printed.*

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141*a*. Supplementary Return to No. 141. Presented 13th April, 1910... .. .. ..*Not printed.*

142. Return to an order of the House of Commons, dated 24th November, 1909, showing the total amounts paid by the government in each year since 1896, for all printing, advertising and lithographing done outside of the Government Printing Bureau; the total amount so paid by each department of the government for such purposes during each year; the names and addresses of each individual, firm or corporation to whom any such moneys have been so paid, and the total amount paid to each individual, firm or corporation in each year since 1896. What portion of the said sums, if any, so paid since 1896, was expended after public advertisement, tender and contract, to whom such tenders were awarded, whether to the lowest tender in each case, what portion was expended otherwise than by public advertisement, tender and contract, and to whom it was paid in each instance. Presented 23rd March, 1910.—*Mr. Armstrong.*
Not printed.

143. Return to an order of the House of Commons, dated 19th January, 1910, showing: 1. How much money has been paid by this government from 1896 to the present time to the firm of Sullivan & Langdon, contractors, of Kingston, or to Mr. Sullivan, contractor, Kingston. 2. What public buildings or other public works that have been let by contract to either of the above firms since 1896, the contract price in each case, and the total amount paid to the said contractors in each case. 3 The total cost of each building or public work in which either of the above mentioned firms was interested. Presented 23rd March, 1910.—*Mr. Edwards*.. .. ..*Not printed.*

144. Return to an order of the House of Commons, dated 19th January, 1910, showing: 1. All amounts which may be deducted from the allowances due officers commanding corps of the active militia to cover deficiencies in clothing, &c., deposited to the credit of the Receiver General of Consolidated Revenue. 2. The amount of money that has been received from officers commanding corps of active militia during the five years ended 31st March, 1909, in payment for clothing issued to such corps, including deductions from allowances to cover repayment to replace deficiencies. Presented 30th March, 1910.—*Mr. Worthington*.. .. ..*Not printed.*

145. Rules of the Supreme Court of Saskatchewan, under the provisions of section 576 of the Criminal Code. Presented 30th March, 1910, by Hon. A. B. Aylesworth.
Not printed.

146. Copy of correspondence between the Canadian government and the government of Great Britain in respect to the purchase by Canada of the cruiser *Rainbow*. Presented 30th March, 1910, by Sir Wilfrid Laurier.. .. .. ..*Printed for sessional papers.*

146*a*. Copy of correspondence between the Canadian government and the government of Great Britain in respect to the purchase of the cruiser *Niobe*. Presented 30th March, 1910, by Sir Wilfrid Laurier.. .. ..*Printed for sessional papers.*

147. Return to an order of the House of Commons, dated 7th February, 1910, for a copy of all correspondence respecting the Central Park Post Office during the year 1909 and including particularly a copy of: 1. Representations made to the department that by changing the location of the office and establishing a post office at Collingwood East, the interest of the majority of the residents would be best served. 2. The evidence taken at the inquiry following such representations, and the official report upon such evidence. 3. Communications from residents of Central Park and others with respect to the closing of the post office there, and the answer made thereto in accordance with the facts. 4. The information upon which it was determined that the removal of the post office would be a greater convenience. 5. The largely signed petition from patrons

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of the Central Park Post Office complaining of the management, &c.; and the report of the inspector who investigated the same. Presented 31st March, 1910.—*Mr. Taylor (New Westminster)*.. .. ..*Not printed.*

148. Return to an order of the House of Commons, dated 14th March, 1910, showing, for the last two months, the time of each transmission of mails from Montreal to London, England, and from London, England, to Montreal and showing the date and hour of closing, and date and hour of delivery in each case. Presented 31st March, 1910.—*Mr. Monk*.. .. ..*Not printed*

149. Return to an order of the House of Commons, dated 14th March, 1910, showing the names of the sessional and temporary employees of the House of Commons who were under pay on the 27th January last; and the number of the said employées stated in the estimates of 1909-10. Presented 31st March, 1910.—*Mr. Best.*
Printed for sessional papers.

150. Return to an order of the House of Commons, dated 24th January, 1910, for a copy of all correspondence between Celstin Pregent, of Melocheville, P.Q., either personally or through his attorney, and the Department of Railways and Canals, concerning certain bridges on the Beauharnois canal. Presented 31st March, 1910.—*Mr. Monk.*
Not printed.

151. Return to an order of the House of Commons, dated 14th March, 1910, showing what amount of money has been paid each year to Geo. Walton, Manitoba, by the Interior Department, from January 1st, 1906, to December 31st, 1909; and what monies Mr. Geo. Walton has received since January 1st, 1909, from any other department of the government. Presented 4th April, 1910.—*Mr. Schaffner*.. .. ..*Not printed.*

152. Return to an order of the House of Commons, dated 7th February, 1910, for a copy of all correspondence relating to all coal lands reserved for as well as those acquired by the Bow River Collieries by direct application or assignment. Presented 4th April, 1910.—*Mr. Northrup*.. .. ..*Not printed.*

153. Report of Harry Freeman Alward, Commissioner appointed to investigate into the matter of complaints concerning James Dickson, government valuator, Trent canal, pursuant to Part II, of the Inquiries Act, Revised Statutes of Canada, 1906, held at Peterborough and Hastings, Ontario, March 22th to March 29th, inclusive, 1910; and also a copy of the evidence in relation thereto. Presented 5th April, 1910. by Hon. G. P. Graham.. .. ..*Not printed.*

154. Return to an order of the Senate, dated 14th January, 1910, for a statement comprising, in so many distinct columns, the names, dates and appointment, nature of employment, salary, travelling expenses, and indication of the section where the person was employed, of all persons in the service of the Commission for the construction of the Grand Trunk Pacific Railway between Moncton and Winnipeg. Presented 6th April, 1910.—*Hon. Mr. Bolduc*.. .. ..*Not printed.*

155. Return to an order of the House of Commons, dated 14th February, 1910, for a copy of all pay-sheets, accounts, and vouchers for wages, material and expenditure in connection with work on Skinner's Cove, Boat Harbour, Pictou County, Nova Scotia, in the years 1907, 1908 and 1909. Presented 8th April, 1910.—*Mr. Stanfield*..*Not printed.*

CONTENTS OF VOLUME 19—*Continued.*

155*a*. Return to an order of the House of Commons, dated 14th February, 1910, for a copy of all payments, accounts and vouchers for wages, materials and other expenditures in connection with work on the Toney river, Boat Harbour, Pictou County, Nova Scotia, in the years 1907, 1908 and 1909. Presented 8th April, 1910.—*Mr. Rhodes.*
Not printed.

156. Return to an order of the House of Commons, dated 15th December, 1909, showing: At what places in the several provinces armouries and drill halls have been erected, and when they were erected; the total cost of the site in each case, and when and from whom purchased; the contract price of each building, and to whom and when the contract was awarded; the total cost of each building; in what places armouries and drill halls are being constructed at present, and the cost of the site, from whom and when purchased; the estimated cost of the building in each case, and to whom, when and at what price the contract was awarded, and the names of places other armouries and drill halls are to be built by the government in the near future. Presented 8th April, 1910.—*Mr. Edwards*.. .. ..*Not printed.*

156*a*. Suplementary Return to No. 156. Presented 14th April, 1910.. .. ..*Not printed.*

157. Return to an order of the House of Commons, dated 28th February, 1910, for a copy of all correspondence, accounts, vouchers and reports, relating to the accident at Sault Ste. Marie lock in June, 1909; the number of vessels and tonnage with port of destination, and number of passengers passing through the Canadian lock at Sault Ste. Marie, during the months of April to December, both inclusive, 1909. Presented 8th April, 1910.—*Mr. Boyce*.. .. ..*Not printed.*

158. Return to an order of the House of Commons, dated 28th February, 1910, for a copy of the original field notes of the survey of Captain Jemmett, 1889, on Chu-Chu-Way-Ha Reserve, No. 2, Similkameen District, B.C. Presented 14th April, 1910.—*Mr. Burrell.*
Not printed.

159. Return to an order of the House of Commons, dated 14th February, 1910, for a copy of all pay sheets, accounts and vouchers for wages, materials and other expenditures in connection with work on the Causeway between Cariboo and Cariboo Island, Pictou County, Nova Scotia, in the years 1907, 1908 and 1909. Presented 14th April, 1910.—*Mr. Borden (Halifax)*.. .. ..*Not printed.*

160. Statement of representation made to the Honourable the Minister of Labour by interviews and in the form of correspondence in respect of Bill No. 101, 'An Act for the investigation of combines, monopolies, trusts and mergers which may enhance prices or restrict competition tothe detriment of consumers.' Presented 14th April, 1910, by Hon. W. L. M. King.. .. ..*Not printed.*

161. Return to an order of the House of Commons, dated 14th March, 1910, for a copy of all papers and correspondence relating to the sale and refund of the money paid on the sale of the n.e. ¼ section of section 11, township 1, range 9, west of the 1st meridian in Manitoba. Presented 15th April, 1910.—*Mr. Sharpe (Lisgar)*..*Not printed.*

162. Return to an order of the Senate, dated 7th April, 1910, for a copy of all correspondence or petitions received by the government from Manitoba grain growers in connection with terminal elevators, especially a letter dated the 31st January, 1910. Presented 14th April, 1910.—*Hon. Mr. Kirchhoffer*.. .. ..*Not printed.*

CONTENTS OF VOLUME 19—*Continued.*

163. Return to an address of the Senate, dated 11th March, 1910, for the production of the report of every inquiry made and of all correspondence exchanged during the last five years on the subject of one or more seizures of goods consigned to or the property of the Quebec Rock City Tobacco Company, as well as on the subject of every remission of fines incurred by the said company for infraction of the Inland Revenue laws or regulations. Presented 14th April, 1910—*Hon. Mr. Landry*.. .. ..*Not printed.*

164. Return to an order of the House of Commons, dated 7th February, 1910, showing the number of persons appointed as temporary employees of the civil service in the several departments since the present Civil Service Act came into force, the date of the appointment of each, their names, their salaries while employed as such temporary employees, the department in which such employee was placed, the duration of their employment, whether in one department alone or in case of transfer to another or other department, with total length of time employed, the names of those who in consquence of having passed the Civil Service examination have been employed permanently, the names of those who while temporarily employed failed to pass the required examination and are still employed in the service; the names of those who are or have been employed over the statutory six months as temporary employees, and the reasons for such continued employment in each case. Presented 18th April, 1910.—*Mr. Hughes.*
Not printed.

165. Return to an order of the House of Commons, dated 19th January, 1910, for a copy of all papers, letters, telegrams, documents and correspondence in connection with the establishment of the Experimental Farm near Lethbridge, Alta. Presented 18th April, 1910.—*Mr. Magrath*.. .. ..*Not printed.*

166. Certified copies of reports of the Committee of the Privy Council of 17th Januray, 1908, and of the 14th November, 1908, respecting a homestead entry granted to Mr. Charles D. T. Becher, for the n.e. ¼ of section 20, township 52, range 24, west of the fourth meridian, &c. Presented 18th April, 1910, by Hon. F. Oliver.. .. ..*Not printed.*

167. Return to an order of the Senate, dated 10th February, 1910, of all surveys, plans, reports and other documents connected with the improvement of the Saskatchewan river, with a view to facilitate transportation by water of passengers and freight from the foot of the Rocky Mountains to the city of Winnipeg, Man. Presented 19th April, 1910.—*Hon. Mr. Davis*.. .. ..*Not printed.*

168. Return to an order of the House of Commons, dated 24th November, 1909, for a copy of all correspondence and papers, and any information possessed by the government relating to the formation and work of the Secretariat decided upon by the Imperial Conference of 1907. Presented 20th April, 1910.—*Mr. Foster.*
Printed for both distribution and sessional papers.

169. Correspondence between the Clerk of the House and the Department of Justice with reference to the organization of the staff of the House of Commons. Presented 21st April, 1910, by Hon. W. S. Fielding.. .. ..*Not printed.*

170. Certified copy of a report of the Committee of the Privy Council, approved by His Excellency the Governor General on the 15th April, 1910, in respect to chapter 10 of the Statutes of Ontario, 1909, intituled: 'An Act to amend an Act to chapter 19 of the Statutes of Ontario, 1909,' intituled: 'An Act to amend an Act to provide for the transmission of Electrical Power to Municipalities,' to validate certain contracts entered into with the Hydro-Electric Power Commission of Ontario, and for other purposes.' Presented 25th April, 1910, by Hon. A. B. Aylesworth.. .. .. ..*Not printed.*

CONTENTS OF VOLUME 19—*Continued.*

171. Return to an order of the House of Commons, dated 14th March, 1910, for a copy of all papers and correspondence between different persons or companies and the Department of Mines, in reference to a charge of unprofessional conduct made in the *Canadian Mining Journal* of July 1, 1909, against Mr. Fritz Cirkle, a mining engineer, temporarily employed by the Department of Mines in preparing a report on the asbestos mining industry of the province of Quebec. Presented 27th April, 1910.—*Mr. Smith (Nanaimo)*.. .. .. .

CONTENTS OF VOLUME 19—*Continued.*

178. Return to an order of the House of Commons, dated 28th February, 1910, for a copy of all reprsentations made by business or commercial men or citizens of Winnipeg to the department or government since the contemplated action of the government in reference to closing or keeping open the post office to box holders on Sundays, and who made them; and of all orders given by the Postmaster General or his department to the postmasters in reference to this Sunday closing. Presented 2nd May, 1910.—*Mr. Haggart (Winnipeg)*.. .. ..*Not printed.*

178*a*. Supplementary Return to No. 178. Presented 2nd May, 1910.. .. ..*Not printed.*

179. Return to an order of the House of Commons, dated 17th November, 1909, for a copy of all accounts, vouchers, correspondence, reports and other papers, not already brought down in connection with the survey of the St. John River channel between Fredericton and Woodstock, N.B. Presented 2nd May, 1910.—*Mr. Crocket*..*Not printed.*

180. Return to an address of the Senate, dated 17th March, 1910, for all documents, letters, returns, &c., concerning the damming of the river La DéCharge, near Lake St. John, in the district of Chicoutimi; which returns are to the effect of showing whether it would be possible to maintain the level of Lake St. John at a reasonable height in order to ensure serviceable navigation on that lake and its tributaries. Presented 2nd May, 1910.—*Hon. Mr. Choquette*.. .. ..*Not printed.*

181. Return to an address of the House of Commons, dated 14th February, 1910, for a copy of all orders in council, reports, correspondence, documents and papers not already brought down relating to the construction of the Georgian Bay canal, or any portion thereof, relating to the surveys thereof, and all offers, proposals and written negotiations not already brought down, with respect to the construction of the said canal or any portion thereof by any company, corporation or syndicate, or with respect to the guarantee by the government of bonds or debentures for the purpose of raising the necessary capital for the construction of the said canal. Presented 3rd May, 1910.—*Mr. White (Renfrew)*.. .. ..*Not printed.*

182. Return to an address of the House of Commons, dated 17th January, 1910, showing the various commissions appointed for all purposes by the government since July 1896, the person or persons composing the commission and the date of appointment, the purpose for which appointed, the date of completion of the work in each case, and the cost of each under the head (*a*) salary, (*b*) travelling expenses, and (*c*) printing report, if any; the word 'commissions' to include the missions of ministers, single or associated, going on public account to the countries outside of Canada. Presented 3rd May, 1910.—*Mr. Foster*.. .. ..*Not printed.*

182*a*. Supplementary Return to No. 182. Presented 3rd May, 1910.. .. ..*Not printed.*

183. Return to an order of the House of Commons, dated 28th February, 1910, showing the number of persons in the employ of each department of the government during the year 1909 under the following heads: (*a*) civil service employees at Ottawa; (*b*) civil service employees outside of Ottawa; (*c*) in stated and regular employ, but not under the Civil Service Act, giving the distinctive service of each group; (*d*) those in temporary or casual employment, giving the distinctive work of each group, and also showing the total amount paid under each head. Presented 3rd May, 1910.—*Hon. Mr. Foster*.. .. ..*Not printed.*

184. Return to an order of the Senate, dated 2nd May, 1910, showing for each of the last ten years the date of the prorogation of parliament and the date on which the bound statutes of the session were distributed. Presented 4th May, 1910.—*Hon. Mr. Power.* *Not printed.*

DEPARTMENT OF THE INTERIOR

ANNUAL REPORT

OF THE

TOPOGRAPHICAL SURVEYS BRANCH

1908-1909

PRINTED BY ORDER OF PARLIAMENT

OTTAWA
PRINTED BY C. H. PARMELEE, PRINTER TO THE KING'S MOST EXCELLENT MAJESTY
1910

[No. 25b—1910]

ERRATA.

Page 213.—On the second line of the third paragraph under the heading 'Survey,' 'southeast' should read 'southwest'; 'west' should read 'north.'

Page 222.—On the second line of the third paragraph under the heading 'Survey,' 'southeast' should read 'northwest.'

Page 229.—On the last line of the third paragraph under the heading 'Survey,' '1' should read '2.'

Page 232.—On the first line of the last paragraph under the heading 'Topographical Description,' 'west quarter' should read 'west half'; 'southeast' should read 'southwest.' On the second line of the same paragraph. '26' should read '28.'

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REPORT

OF THE

SURVEYOR GENERAL OF DOMINION LANDS

1908-1909

DEPARTMENT OF THE INTERIOR,
TOPOGRAPHICAL SURVEYS BRANCH,
OTTAWA, May 27, 1909.

The Deputy Minister of the Interior,
Ottawa.

SIR,—I have the honour to submit the following report of the Topographical Surveys Branch for the fiscal year ended March 31, 1909.

During 1908 there was a demand for extensive surveys in what was formerly called the 'semi-arid' district, those portions of the northwest provinces lying between the Canadian Pacific railway and the international boundary and between Moosejaw and Lethbridge. About one hundred and forty-five townships in this district were subdivided during the year. It is expected that the surveys in this tract will be completed during 1909. Surveys were also extended in the country north and west of Edmonton, north and east of Prince Albert and in the northern part of Manitoba.

To secure more permanent monuments for quarter section corners it was decided to use iron posts instead of wooden ones. Formerly iron posts were used only at section corners. Many surveys in wooded country are performed during the winter. Iron posts as well as being more permanent are much more easily driven into the frozen ground.

Formerly the laws governing the survey of Dominion lands were comprised within the Dominion Lands Act, but in 1908 they were embodied in a separate Act called the Dominion Lands Surveys Act which was assented to March 17, 1908. The chief changes by the new Act are in relation to the resurveys of lands and the correction of errors; the Minister is given power to order a resurvey upon receipt of a petition from the owners of the lands or from parties interested as homesteaders, licensees, &c., and after public notice has been given in the *Canada Gazette* and a local newspaper for a period of four weeks. In the case of the correction of errors provision is made for compensation on account of the loss of improvements by the correction. This compensation is payable by the party acquiring the improvements, and the amount is fixed by the Minister or by an award of three arbitrators. Several resurveys and a few correction surveys have been already made under the provisions of the new Act.

SURVEYS FOR THE YEAR ENDED MARCH 31, 1909.

Like the spring of 1907, the spring of 1908 was unusually wet and surveyors had great difficulties in taking their outfits and supplies to the different localities where they were to work. Progress in the early part of the season was slow but after the wet period was over, the weather generally was very favourable for survey operations. Comp'ete subdivison was made of three hundred and twelve whole and of twenty-three

fractional townships, while a partial subdivision was made of one hundred and sixty-one other townships. In addition a complete resurvey was made of fifteen whole townships and of five fractional ones as well as a partial resurvey of one hundred and fifty-one others.

Seventy survey parties were in the field, sixty of which were engaged on township work and ten on miscellaneous surveys. Thirty-nine of these parties were paid by the day and thirty-one worked under contract. Of the parties under daily pay, four were employed in Manitoba, six in Saskatchewan, fifteen in Alberta, eight in British Columbia, one on the boundary between British Columbia and Yukon Territory and two in the Northwest Territories, while three others were part of the time in one province and part of the time in another. Of the parties under contract seven were located in Manitoba, eight in Saskatchewan and fifteen in Alberta, while one contract was partly in one province and partly in another.

Five parties under daily pay in charge of Messrs. P. R. A. Belanger, E. W. Hubbell, G. J. Lonergan, C. F. Miles and L. E. Fontaine were engaged for the greater part of the time on the inspection of surveys performed under contract. Forty contracts were examined during the year. The balance of the time of the inspectors was given to the investigation of reported errors, the correction of errors and the performance of other miscellaneous surveys.

The reports of the surveyors who were working under daily pay are given as appendices No. 13 to No. 50 of this report. The field of operations embraced the country extending from the eastern boundary of Manitoba to the western boundary of Alberta and from the international boundary as far north as township 107, a distance of about 650 miles. It embraced, also, almost the entire railway belt in British Columbia.

MISCELLANEOUS CORRECTION, RESTORATION AND TOWNSHIP SUBDIVISION SURVEYS.

Mr. C. F. Aylsworth, D.L.S., continued resurvey work in the vicinity of Beausejour, in eastern Manitoba.

Messrs. C. E. Bourgault, D.L.S., and W. J. Deans, D.L.S., made several correction surveys and some resurveys in eastern Saskatchewan. Mr. Deans travelled more than 500 miles during the performance of his surveys. He found the great need in that country to be an adequate system of drainage.

Messrs. T. A. Davies, D.L.S., Jas. Warren, D.L.S., and W. H. Young, D.L.S., were engaged in extending subdivision surveys in southwestern Alberta, in the foothills of the Rocky mountains. Owing to the nature of the country survey operations in this vicinity are very tedious and difficult.

Mr. Thos. Fawcett, D.T.S., retraced a portion of the fourth meridian in southern Alberta and made several correction surveys in Saskatchewan. His report contains an interesting description of the country he passed over.

Messrs. Geo. McMillan, D.L.S., W. R. Reilly, D.L.S., and R. H. Montgomery, D.L.S., were engaged in miscellaneous resurveys and correction surveys in the vicinity of Prince Albert, Saskatchewan. Mr. Reilly expresses the opinion that the north country offers special inducements to the settler of small means, as the wooded homestead furnishes timber for building and wood for fuel, while winter employment may always be had with the lumbering companies.

Mr. T. H. Wiggins, D.L.S., was engaged for only a short period on a correction survey near Saskatoon, Saskatchewan.

SUBDIVISION SURVEYS IN THE PEACE RIVER DISTRICT.

Messrs. H. S. Holcroft, D.L.S., J. B. Saint Cyr, D.L.S., and H. W. Selby, D.L.S., were employed on necessary township subdivision and settlement surveys in the Peace River district. They all speak well of the success which settlers are meeting with in that country and foretell a prosperous future, when satisfactory means of transportation will be available.

SURVEYS OF BLOCK OUTLINES.

Portions of the eighth and ninth base lines west of the principal meridian were resurveyed by Wm. Christie, D.L.S., to locate an error which was indicated by the closings of these lines with other lines previously surveyed. The accuracy of subdivision surveys depends on the accuracy of the base lines; it was therefore necessary to locate and correct the error before the dependent subdivision surveys could be proceeded with.

Mr. A. H. Hawkins, D.L.S., surveyed a portion of the twelfth base and completed the survey of the thirteenth base west of the sixth meridian while Mr. A. Saint Cyr, D.L.S., surveyed a portion of the fifteenth base west of the fifth meridian and produced the sixth meridian from the fourteenth base south to the quarter section corner on the east boundary of section 25 in township 47. A perusal of the reports of Messrs. Hawkins and Saint Cyr will give a clear idea of the almost insurmountable difficulties encountered by surveyors who undertake the surveys of the governing lines in our system of survey.

Mr. A. W. Ponton, D.L.S., produced the fifth initial meridian through townships 85 to 107, inclusive. It was necessary to establish this meridian in order that base lines might be extended from it in any direction where subdivision may be required. Large settlements are already in existence on Peace river and there is some demand for subdivision surveys.

Mr. B. J. Saunders, D.L.S., produced the eleventh base line west of the fifth meridian from range 8 to range 19.

MISCELLANEOUS SURVEYS.

Mr. David Beatty, D.L.S., made a compass survey of the limits of Porcupine forest reserve northwest of Swan River, Manitoba.

Mr. A. McFee, D.L.S., surveyed the boundaries of Buffalo Park reserve near Hardisty, Alberta.

Some necessary surveys at The Pas in the Northwest Territories were performed by Mr. E. R. Bingham, D.L.S. He foretells an important future for this settlement when the Canadian Northern Railway is completed that far.

Mr. P. A. Carson, D.L.S., continued the triangulation in the railway belt, British Columbia, south and west of Golden.

A survey to locate some coal lands on the south branch of Brazeau river in Alberta was made by Mr. T. D. Green, D.L.S.

Mr. J. E. Morrier, D.L.S., surveyed a townsite at Fort Churchill. His report gives much valuable information as to the conditions of life there and the possibilities of the country.

Necessary surveys at lakes Louise and Minnewanka, in the Rocky Mountains park, were done by Mr. A. C. Talbot, D.L.S.

Mr. W. Thibaudeau, C.E., made a preliminary investigation of the water-powers of several streams in southwestern Alberta. A mass of valuable information is furnished by his report and the maps to accompany it, which are published herewith.

Mr. J. N. Wallace, D.L.S., established the Yukon-British Columbia boundary between the Tatshenshini and Takhini rivers, a distance of about thirty-six miles.

An examination of the vacant lands in the valleys of the railway belt, British Columbia, was undertaken by Mr. A. O. Wheeler, D.L.S., for the purpose of classifying them under five heads, viz., fruit land, farming land, grazing land, timber land and worthless land. Mr. Wheeler had under his direction two sub-parties in charge of Messrs. M. P. Bridgland, D.L.S., and H. G. Wheeler respectively. The valley lands above and below Revelstoke and above Golden were examined.

BRITISH COLUMBIA SURVEYS.

For some years past two surveyors Messrs. J. E. Ross, D.L.S., and A. W. Johnson, D.L.S., have conducted practically all the Dominion land surveys in the railway belt. Owing to the great increase of work consequent upon the assumption by the Department of the control of timber berth surveys and upon the considerable increase in the applications for subdivision surveys it was found necessary last year to employ two more parties under Messrs, T. H. Plunkett, D.L.S., and E. W. Robinson, D. L.S., respectively. These two parties as well as the party under Mr. A. W. Johnson, were engaged in the Kamloops district. Mr. J. E. Ross was employed in the western portion of the railway belt. Some small surveys were performed by Mr. J. A. Kirk, D.L.S.

LATITUDE ON THE FIFTH MERIDIAN.

In the spring of 1908 Mr. G. Blanchard Dodge determined the latitude of the fifth meridian near the Athabaska river in order to ascertain the error in latitude of the corner monuments near that place. The fifth meridian was being extended northerly to the Peace river by Mr. A. W. Ponton and to guard against errors in chainage, he was instructed to observe for latitude from time to time, but this could not serve as a check unless he knew the error at his starting point near the Athabaska river. It was shown by Mr. Dodge's observation that the error was practically nothing.

The following is a comparison of the mileage surveyed every year since 1906:—

	April 1, 1908, to March 31, 1909.	April 1, 1907, to March 31, 1908.	Jan. 1, 1906, to March 31, 1907.
	Miles.	Miles.	Miles.
Township outlines	2,019	1,674	1,306
Section lines	16,985	13,710	8,962
Traverse	3,323	3,193	1,848
Resurvey	2,175	2,917	4,948
Total for season	24,502	21,494	17,064
Number of parties	67	59	56
Average miles per party	366	364	305

The following table shows the mileage surveyed by the parties under daily pay, and by the parties under contract:—

WORK OF PARTIES UNDER DAILY PAY.

	April 1, 1908, to March 31, 1909.	April 1, 1907, to March 31, 1908.	Jan. 1, 1906, to March 31, 1907.
	Miles.	Miles.	Miles.
Township outlines	512	542	756
Section lines	1,004	975	1,035
Traverse	1,158	1,313	643
Resurvey	2,175	2,782	4,815
Total for season	4,849	5,612	7,249
Number of parties	36	29	29
Average miles per party	135	194	250

WORK OF PARTIES UNDER CONTRACT.

	April 1, 1908, to March 31, 1909.	April 1, 1907, to March 31, 1908.	Jan. 1, 1906, to March 31, 1907.
	Miles.	Miles.	Miles.
Township outlines	1,507	1,132	550
Section lines	15,981	12,735	7,927
Traverse	2,165	1,880	1,205
Resurvey		135	133
Total for season	19,653	15,882	9,815
Number of parties	31	30	27
Average miles per party	634	529	364

NOTE.—Owing to the nature of their work the parties under Messrs. P. A Carson, W. Thibaudeau and A. O. Wheeler are not included in the statement of mileage for the year ended March 31, 1909.

The following statement shows the average cost per mile of surveys done by contractors and by surveyors under daily pay for the year ended March 31, 1909:—

	Surveys made under day pay.	Surveys made under contract.
Total mileage surveyed	4,849	19,653
Total cost	$ 323,054 13	$ 358,364 61
Average cost per mile	66 62	18 23

DESCRIPTIONS OF TOWNSHIPS.

Descriptions of the townships subdivided during the year have been compiled from the surveyors' reports and are given as appendix No. 51 of this report. The descriptions are in the order of township, range and meridian and are preceded by a list of the townships described.

A map accompanies this report which shows in different colours the surveys performed prior to March 31, 1908, the subdivision surveys between March 31, 1908, and March 31, 1909, and the resurveys during the same period.

ALLOWANCES AND REMUNERATION FOR SURVEYORS UNDER DAILY PAY.

In order to induce properly educated men to qualify as Dominion land surveyors, so that the Department would have no difficulty in securing the services of competent men to carry on the surveys according to the improved, accurate and scientific methods of the present day, an Order in Council was passed on April 6, 1908, increasing the rates of pay from $6.50 to $7.50 per day for ordinary and block outline surveys to $8 and $10 per day, respectively. The remuneration of Inspectors of Surveys who are employed continuously was set at $9 per day while in the field and $5 per day while engaged at office work. Allowances to surveyors engaged under daily pay were set by Order in Council of April 11, 1905. These allowances were intended only for surveyors in charge of full survey parties and were found insufficient when a surveyor was engaged on a survey where he was accompanied by an assistant only. To meet this case a living allowance of $2.50 per day each was granted to the surveyor and his assistant by Order in Council of October 16, 1908.

RATES FOR SUBDIVISION SURVEYS.

Previous to the spring of 1908 the rates for subdivision surveys had been fixed by several Orders in Council. For convenience of reference and to better define the

different classes of work and thus remove causes for differences of opinion between contractors and the Department these several orders were consolidated by Order in Council of May 12, 1908. No change was made in the rates. The schedule of rates annexed to the Order in Council is as follows:—

Schedule of rates to be paid for township subdivision surveys of Dominion Lands executed under contract.

1. Section lines shall be paid for at the rate of three dollars and fifty cents per mile of line surveyed.

2. A further payment at the rate of fifty cents per chain up to ten chains in a section side, shall be made for opening, cutting and blazing the line through woods, windfalls, underbrush or heavy scrub.

3. Any opening, cutting and blazing of the line in excess of ten chains in a section side shall be paid for at the rate of twenty-five cents per chain. If the mileage charged for by the contractor for opening, cutting and blazing of lines exceeds that reported by the Inspector of Surveys, the contractor's account shall be reduced accordingly, the deduction being applied over the whole contract. No deduction, however, shall be made if the contractor's charge does not differ from the Inspector's by more than five per cent. If the lines are not sufficiently blazed a deduction may be made at such rate as the Inspector of Surveys recommends, but not exceeding two dollars per mile.

4. For the interpretation of Clauses 2 and 3, a section line shall mean the distance between two monuments at section corners or the places assigned to such corners, and this distance may include a road allowance.

5. No payment shall be made under the provisions of Clauses 2 and 3 where the line could have been measured without opening and cutting. A strict interpretation shall be given to these clauses and the field notes must show every opening of half a chain or more where no cutting was necessary in order to measure the line.

6. The part of a line chained across a marsh or other body of water, except on the ice, or measured across water by means of a triangulation, shall up to half a mile, be paid for as opening through woods when the body of water is surrounded by continuous woods. When such measurement exceeds a mile in length, one-half the distance shall be paid for as opening through woods. Distances measured by means of improper triangles shall not be paid for.

7. When the side of a section, exclusive of road allowance, is greater than ninety chains or smaller than seventy chains, the number of chains of opening or cutting which may be paid for at the rate of fifty cents per chain shall be increased or reduced in proportion to the length of the section side.

8. Only the lines actually run and marked in the field shall be paid for. Nothing shall be allowed for random and trial lines, bases of triangles and offsets. A single payment only shall be made for the north and south boundaries of townships, although they must always be run twice under the provisions of the Manual of Survey.

9. A further payment at the rate of three dollars per mile shall be made for section lines surveyed over rough or hilly country. A section side shall be classed as rough or hilly when the field notes show that it crosses a ravine not less than 100 feet deep or two ravines not less than fifty feet deep, or that the difference of level between two points of the line not more than half a mile apart exceeds 200 feet, the depths or heights being measured by aneroid barometer. In case the corner of the section falls in the ravine or on the side of the hill, payment shall be made for either of the adjoining sections but not for both.

10. A further payment at the rate of four dollars per mile may be made upon a report of the Inspector of Surveys, concurred in by the Surveyor General, stating that the survey presented unusual difficulties on account of large rivers flowing through

deep valleys with the surrounding country broken by gullies; or on account of exceptional extensive and deep marshes. This payment shall not be made for difficulties other than those mentioned or for marshes which have been crossed on the ice. Payment, if made, shall be for the number of miles recommended in the Inspector's report.

11. A further payment at the rate of four dollars per mile shall be made for surveying the meridian outlines of a township when such outlines are included in a subdivision survey contract, but such payment shall not be made for resurveying or retracing lines previously surveyed.

12. Section lines resurveyed or retraced by direction of the Surveyor General, or under the provisions of the Manual of Survey, shall be paid for at the same rate as original section lines in the subdivision of a township, but no payment shall be made for the part of an outline chained under the provisions of the Manual of Survey for testing the chainage. Lines resurveyed or retraced without authority shall not be paid for. The fact that a line is obliterated or that a monument cannot be found shall not be deemed sufficient authority to resurvey or retrace the line.

13. A further payment at the rate of twenty-five cents per pit in prairie, and forty cents per pit in the woods, shall be made for erecting a boundary monument, such payment to cover the cost of planting and marking the post, building the mound and otherwise completing the monument. A witness trench shall be paid for as four pits. A stone mound shall be paid for as four pits in the woods. A long quarter section post planted in a marsh shall be paid for as two prairie pits.

14. Traverses of lakes and rivers and connecting traverses shall be paid for at the rate of eleven dollars per mile, for traverses of lakes and rivers, the distance to be paid for shall be measured along the bank of the lake or river from every point fixed by the survey in a straight line to the next point. Nothing shall be paid for offsets, but one dollar shall be deducted for every offset short of the number required by the Manual of Survey.

15. One dollar shall be paid for every statutory declaration of a settler.

16. A payment at such rate as the Surveyor General may allow, but not exceeding two dollars per mile of township outline or section line surveyed, may be made for the determination of the astronomical direction of the line of the survey.

17. The above allowances shall cover the cost of preparing the returns of the survey.

18. Iron posts used on the survey of Dominion lands will be suplied free of cost at Winnipeg and at every other place where they are kept in stock. Posts not used shall, if not returned to stores, be charged to the surveyor at forty cents each.

19. A deduction at the rate of six cents per cubic foot for deficiency in the size of the pits in excess of a foot and a half per pit shall be made from the payments to survey contractors. Further deductions at such rates as the Inspector of Surveys may recommend, shall be made for deficiencies in survey monuments, whether the deficiency be in the scattering of earth away from the pits, the marking or driving of the posts or in the general character of the monuments. These deductions shall be averaged on the monuments examined by the Inspector and shall be applied to the whole contract, Should the total amount of the deductions calculated as above, exceed thirty per cent of the amount allowed for erecting the monuments, or should the Inspector report that the monuments are too unsatisfactory to be accepted, the contractor shall be required to repair and correct them according to the standard required by the Manual of survey.

20. The lines embraced in any survey under contract must be surveyed by the surveyor in person; no payment shall be made on such contract work if otherwise performed.

SUPPLEMENT TO THE MANUAL OF SURVEY.

In 1892 a fourth edition of the Manual of Instructions for the Survey of Dominion Lands was issued containing thirteen tables specially adapted to the survey of Dominion lands. The fifth and sixth editions issued in 1903 and 1905, respectively, contained only eight tables. The tables omitted were those seldom used and it was thought that when needed they could be referred to in the fourth edition.

The fourth edition having become scarce a reprint of the tables was necessary. The Manual proper, owing to the nature of its contents, has to be revised at frequent intervals and as no change is necessary in the tables it was considered advisable to publish them separately as a supplement. This has been done and the supplement in a convenient form has been issued to all Dominion land surveyors and to a few others closely connected with those surveys. It will not be necessary to publish the tables in future editions of the Manual proper.

The construction and use of the tables are fully explained in the supplement and are further elucidated by means of problems connected with the system of survey.

MANUAL OF SURVEY.

Some important changes have been made, since the issue of the sixth edition of the Manual in 1905, in the methods of survey and in the rates of remuneration for surveyors under daily pay. A booklet of amendments was issued in 1906 and a circular making a few further amendments was issued in 1908. The sixth edition of the Manual being almost exhausted, it is necessary to prepare another revision. Amendments and improvements have been introduced where necessary and the manuscript is now almost complete. It is expected that the new edition will be ready for distribution during the coming season.

THE BOUNDARY BETWEEN THE PROVINCE OF BRITISH COLUMBIA AND YUKON TERRITORY FROM TESLIN LAKE TO TATSHENSHINI RIVER.

The boundary between the province of British Columbia and Yukon Territory is defined by the Imperial British Columbia Act of 1866 (29 and 30 Victoria, Chapter 67) as being the sixtieth parallel of north latitude. For other boundaries of the same kind and particularly in marking the forty-ninth parallel between Canada and United States it was agreed that the term, 'parallel of latitude,' means a line passing through all points of the same astronomical latitude, and having between any two adjoining observed latitudes the curvature of the theoretic parallel.

In the year 1898, with the development of the country adjoining the boundary, questions of jurisdiction between the province and the Dominion arose and a demarcation of the boundary became imperative. In November of that year the Provincial Secretary and Minister of Mines, Victoria, B.C., addressed a communication to the Minister of the Interior, calling attention to the necessity of defining the northerly boundary of British Columbia, more particularly of that portion of country situated between the Pacific coast and Teslin lake, and asking the co-operation of the Dominion Government in order to have this boundary line established. The Minister of the Interior directed that the work of defining the boundary should be proceeded with at once, and this was done without the assistance of the province. It is expected, however, that the Provincial Government will adopt the boundary as established by the Dominion officers.

The boundary has been surveyed from Teslin lake to the west crossing of Tatshenshini river, a distance of one hundred and sixty-five miles. Sixteen points on the boundary were established from astronomical observations for latitude on the sixtieth parallel and these points were joined in adjacent pairs by arcs having the curvature of the theoretic parallel; one hundred and fifty additional monuments were established thereon.

From Teslin lake to Takhini river, eleven points were established by G. White-Fraser, D.T.S., in 1899 and 1900, by astronomical observations for latitude with a twelve-inch altazimuth instrument, with two micrometer microscopes reading to one second of arc. The probable error in latitude of any of these points is about twenty feet.

From Takhini river to Tatshenshini river five points were established by J. N. Wallace, D.L.S., in 1907 and 1908, by astronomical observations for latitude with a Troughton and Sims zenith telescope, of twenty-eight-inch focal length. Talcott's method for observing latitude being employed. The probable error in latitude of any of these five points is from six to ten feet.

The intermediate monuments from Teslin lake to Takhini river were established by A. Saint Cyr, D.L.S., in 1899, 1900 and 1901; and those from Takhini river to Tatshenshini river by J. N. Wallace, D.L.S., in 1907 and 1908.

The method employed in establishing the intermediate monuments between stations fixed by astronomical observations is as follows:—Each latitude station was joined to the next one by a line having the curvature of the theoretic parallel at sixty degrees of north latitude, by running, as a trial line, a series of tangents to the prime vertical circles passing through the initial latitude station, and the offsets to the sixtieth parallel were calculated according to the formula:

$$\text{Offset (to parallel from tangent)} = \frac{D^2 \operatorname{Sin} \phi}{2N \operatorname{Cos} \phi}$$

or log of offset (in chains)=2 log D + log C, where D is the distance in chains measured from the points of tangency of the trial line with the assumed, or theoretic parallel passing through the initial astronomical station, and C is a constant whose logarithm is $\overline{6}\cdot4352819$.

In closing on an astronomical station the residual offset due to difference in station error of the two latitude stations was distributed proportionately at all the monuments.

Linear measurements along the trial line were made by Mr. Saint Cyr with a Lugeol micrometer, and by Mr. Wallace by triangulation with chained bases.

The monuments consist of an iron post ,three feet long and three-quarters of an inch in diameter, driven flush with the ground. This iron post defines the boundary. Its position is shown by a wooden post planted beside it, standing, as a rule, about four and one-half feet out of the ground, and surrounded by a circular cairn of stones, or an earth mound, about seven feet in diameter and four feet high. In some cases, owing to the nature of the ground or for other reasons, the iron post was omitted, and the wooden post defines the boundary. A complete description of each monument was recorded by the surveyor and is shown on the plan of the boundary.

Between monument 118 (station L) on Takhini river, and station T, on Hendon river, a distance of nine miles, no monuments were established, owing to the roughness of this part of the country, over which it was impracticable to run the boundary line.

The wooden posts are marked with the letters B. C. (signifying British Columbia) on the south side, and Y. (signifying Yukon) on the north side. The posts are not numbered on the ground, although a system of consecutive numbers has been adopted to designate the monuments, beginning with No. 1 at Teslin lake and ending with No. 166 at the west crossing of Tatshenshini river. It is the intention to have them numbered on the ground according to this system in the near future.

The monuments have been established where the boundary intersects the most important lakes, rivers and valleys, such as Teslin lake, Narrows lake, Happy valley, Atlin lake, Taku arm, Windy arm, Bennett lake, Munroe lake, Partridge lake, Primrose river, Takhini river, Hendon river, Kusawa river, Blanchard river and Tatshenshini river, and also at intermediate points wherever practicable, the distance between the monuments averaging about one mile. In many places ranges of high mountains

have been crossed, the highest point of the boundary line being on Mt. Nevin (elevation 7,259 feet).

A plan of the boundary between the province of British Columbia and Yukon Territory at a scale of one mile to an inch is published in connection with this report. The plan shows the boundary as surveyed from Teslin lake to Tatshenshini river. The monuments are shown by square black marks and the nature of each monument indicated thus: I.P., W.P.M., signifying iron post together with a wooden post and mound. The monuments established by astronomical observations for latitude are distinguished by letters, in addition to their numbers. The distances between the monuments are shown in chains and decimals. The bearings of the lines joining adjacent monuments are shown to the nearest second, and are referred to the meridian passing through each monument. The topography is shown in the immediate vicinity of the boundary line. Elevations are shown in feet above sea-level.

Detailed information regarding the several seasons' surveys, the nature of the country, climate and other miscellaneous data may be found in the reports of G. White-Fraser, D.T.S., and A. Saint Cyr, D.L.S. (Reports of the Department of the Interior, 1900, 1901, 1902), and the reports of J. N. Wallace, D.L.S., for 1907 and 1908 (Reports of the Topographical Surveys Branch, 1907-8 and 1908-9). A few of the photographs taken by the surveyors while working on the boundary accompany this report.

CORRESPONDENCE.

The correspondence consisted of:

Letters received	10,592
Letters sent	13,987

ACCOUNTS.

The accountant's record shows:

Number of accounts dealt with	703
Amount of accounts	$892,231
Number of cheques forwarded	3,622

OFFICE STAFF.

The office staff of the Topographical Surveys Branch at Ottawa consists of one hundred and sixty-eight employees. A list of the staff is given as appendix No. 10. There are at present seventeen vacancies, sixteen in the chief draughtsman's office and one in the geographer's office.

Many changes took place again during the past year in the personnel of the staff.

The following resigned from the staff of the chief draughtsman's office:—

Messrs. J. R. Akins, W. B. Bucknill, P. A. Carson, T. A. Davies, H. S. Day, F. H. Maynard, J. E. Morrier, A. G. Stewart, C. H. Taggart and M. B. Weekes. Messrs. A. S. Cram and C. H. Wilding were transferred to the Land Patents Branch, Messrs. G. A. Grey, J. B. Hutton and S. H. Shore to the Registration Branch and Mr. G. A. Gaudry to the Railway Lands Branch.

Messrs. G. B. Dodge, F. H. Kitto and D. F. Robertson were absent part of the time on surveys in the field.

The following new members were appointed:—Messrs. W. B. Bucknill, M. B. Bonnell, J. P. Cordukes, A. d'Orsonnens, E. J. Ebbs, A. H. Flindt, A. M. Grant, K. D. Harris, J. B. Milliken, J. P. MacMillan, B. E. Norrish, H. Osmond, W. J. Peaker, S. H. Shore, R. S. Stronach and L. N. Wadlin. Mr. H. E. Hayward returned to the staff from the Timber, Grazing and Irrigation Branch where he had been working temporarily.

Mr. W. G. Addison was added to the correspondence staff and Miss M. F. Percival was transferred to the Registration Branch.

Three new members were appointed to the staff of the geographer's office, viz., Messrs. E. D. Bryant and Thos. Grindlay and Miss M. Stewart. Mr. C. G. Wood died; he had been attached to the staff for five years.

Mr. E. E. Bryce was transferred from the Land Patents Branch to the survey records office. Mr. Mudie of this office resigned.

Mr. H. N. Topley of the photographic office has been transferred.

Messrs. E. B. Burnett and P. Kane were appointed to the lithographic office. Mr. H. G. Grant was employed temporarily for three months during the year.

CHIEF DRAUGHTSMAN'S OFFICE.

(P. B. Symes.)

The changes made by the Civil Service Amendment Act of last year have affected this office to a very great extent. For twenty-five years previous to September 1 last all the draughtsmen had been 'temporary employees' with the single exception of the chief draughtsman, although a number of them spent many years in the office. Many, however, remained a very short time and changes were so frequent that it was a continual problem how to arrange the work to the best advantage. The staff being now included in the permanent organization of the service and their remuneration being adequate it is anticipated that changes will in future be few, and this will no doubt tend towards securing a more competent staff, experience in the office itself being of great importance in a branch like this, where the business differs considerably from that in any other office.

The greater permanence of the staff has already shown results in increased efficiency, the routine of the office running more smoothly and more work being turned out without any increase in the number of draughtsmen which is the same as a year ago. This does not mean that we have sufficient help for keeping up with our requirements; in fact we need a considerable increase, being at present sixteen short of the number estimated as necessary and authorized by Order in Council. We are doing the most pressing work but there is much that ought to be done.

The tendency noted in the last report to occupy much of the time of the draughtsmen in correspondence still continues, about six thousand five hundred letters having been drafted in this part of the branch during the year.

The assistant chief draughtsman superintends the preparation of the instructions for surveyors as to the field work allotted to them and this occupies a large part of his time. The instructions vary with every case and often involve a considerable amount of study and research to provide the necessary information to arrange that the work needed in a certain locality shall be done if possible while a surveyor is in the neighbourhood and to avoid overlapping in the distribution of the field work. On the whole, our system seems to be successful; it is very seldom that any misunderstanding arises with reference to the instructions and very seldom that any surveyor has to complain of any incompleteness or mistake in getting them out.

Reports below from the heads of the different divisions give details as to operations carried on in each in the last twelve months.

DRAUGHTING OFFICE—FIRST DIVISION—INSTRUCTIONS AND GENERAL INFORMATION.

(T. E. Brown.)

Owing to the augmentation of the work in this division the staff has been increased from nineteen to twenty-one employees.

Two employees are engaged in preparing instructions to the surveyors in charge of parties in the field. Instructions were drafted for one hundred and twenty-four survey parties. Before instructions for any particular survey can be intelligently

compiled it is necessary to collect all available information as to Dominion land, Indian reserve or other surveys already made in the vicinity; this takes the time of five employees. Nineteen hundred and one sketches and 334 maps and tracings were made to accompany the instructions.

The various office registers, in which a record is kept of the surveys performed each year by each surveyor, and of the progress of each surveyor's work in the field take the whole time of two men. It is very important that these records be carefully and accurately kept, as a slight error might entail difficulties and serious losses to the surveyors, as well as errors in the township and other plans compiled in the office. Thirteen hundred and eight progress sketches were received from surveyors in the field, also 673 books of field notes of township surveys, 77 books and 503 plans of miscellaneous surveys, 276 timber reports, 436 statutory declarations of settlers and 11 sheets of observations for magnetic declination. Returns of the surveys of 300 separate blocks of timber berths were also received.

After complete examination 615 books of field notes were placed on record, together with 429 notes and plans of miscellaneous surveys and 436 statutory declarations.

Plans of 609 townships and 14 settlements or townsites, and 48 sectional maps were received from the lithographic office, posted in the registers and distributed.

Preliminary plans were issued for 416 townships, four copies of each being furnished. Two members of the staff are occupied a considerable part of the time in preparing these plans; the remainder of their time is devoted to preparing sketches for instructions.

One employee deals with communications from settlers and others on miscellaneous subjects, answers inquiries from other branches of the Department and prepares descriptions of parcels of land for the purpose of transfers and patents. The number of communications in this connection was 1,270, involving the preparation of 329 sketches, 38 maps and tracings and 463 pages of copies of field notes.

A set of sectional maps on a scale of three miles to the inch is being prepared, showing the closings of township surveys. These maps illustrate in a convenient form all discrepancies in the surveys and enable the officials when drafting instructions to point out to the surveyors irregularities they may expect to find in the surveys on the ground. Two employees have been engaged the whole year on these maps, twenty-three of which have been completed.

A general report of survey operations from 1869 to 1889 was published in the annual report of the Department of the Interior for 1891. Two members of the staff are now working on a similar report embracing operations up to the present time. The need of such data for reference has been felt for a long time, but, owing to the pressure of other work, its compilation has been deferred from year to year. It is hoped to have it ready for publication in the next annual report of this branch.

It is expected that there will be ready for publication in the same report a short history of photo-topographical survey operations in the Rocky mountains from their inception up to the present. Two other members of this division have this work now in hand. There is at present no comprehensive description of these operations, hence it is expected that this compilation will prove a valuable aid in the office as a reference, and will be of value to persons interested in photographic surveying.

Considerable work is involved in the collection of data for the annual reports of the Branch. Descriptions of the townships surveyed have to be compiled from the field notes. The reports of the surveyors on their operations for the season have to be examined and put in shape for publication. The employee who is editing the annual report devotes the whole of his time to it.

The storage vault for the branch is in charge of another member of the first division. The work of keeping in order the thousands of documents stored there keeps him busily occupied most of the time. In addition, he attends to the distribution of stationery, drawing instruments, &c., to the officials of the Branch.

The Manual of Instructions for the Survey of Dominion Lands was revised in this division. This revision has already been mentioned. The Supplement to the Manual of Surveys was also prepared and proof-read in this division.

Four thousand and ninety draft letters and memoranda were written during the year.

DRAUGHTING OFFICE—SECOND DIVISION—EXAMINATION OF SURVEYORS' RETURNS.

(T. S. Nash.)

In this division all returns of surveys of Dominion lands in the provinces of Manitoba, Saskatchewan and Alberta are examined and the plans of the surveys are compiled. The reports of the inspectors of contract surveys are examined; the contractors are notified of any discrepancies and they are given the opportunity to make the necessary corrections on the ground. These reports are used in finally accepting the work and in making up the accounts for surveys performed under contract.

The progress sketches which show the progress of the work in the field and upon which advances to the contractors are made are examined to see that all the work closes within the limits required by the Manual and that all areas made fractional by water are shown. During the past year, 1,166 of these sketches were examined including 360 sketches from inspectors.

Upon being received the final returns are first given a cursory examination, the purpose of which is to detect any serious omissions or discrepancies and if necessary, they are returned to the surveyor for correction. After this the returns of all previous surveys in the township, townsite, or settlement are collected and the compiling of the plan is proceeded with. During the year, 478 subdivision surveys, 370 outline surveys, and 63 miscellaneous surveys were examined and the compiled plans of 591 townships were sent to the draughtsmen. This number included first edition plans of 331 townships which shows the rapid rate at which the country is being opened up. Compiled plans of 13 miscellaneous surveys were also sent to be drafted. While the compiling is being carried on a very careful examination is made of the returns of the new survey and a memorandum of any discrepancies or omissions is sent to the surveyor. During the year 525 such memoranda were sent, 486 answers to memoranda were received and the necessary corrections made in the returns, and 1,240 letters in connection with the work were drafted.

This division also examined plans of 280 road diversions made by the provincial governments of Saskatchewan and Alberta, 76 plans of right of way of railways, and plans of survey of 74 timber berths.

DRAUGHTING OFFICE—THIRD DIVISION—DRAWING FOR REPRODUCTION.

(C. Engler.)

The staff of this division is smaller than for two or three years past. The nominal strength is thirteen since September 1 last when the employees were admitted into the service on a permanent footing, as compared with fourteen a year ago, and fifteen the year previous. Since September 1, however, one has been permanently transferred and two temporarily employed in another Branch of the Department, one for over a month, the other for nearly three months; at the time of writing the latter is still there. It is needless to add that under these circumstances it is somewhat difficult to keep up with the work of the division.

Owing to the increased demand for space in the building at the corner of Metcalfe and Slater streets it was deemed advisable to move one of the divisions to the Imperial building on Queen street. As the work of this division is for the most part that of preparing plans for printing and consequently does not involve frequent reference to original plans, field notes and files of correspondence, it was thought that this division

could be best separated from the others and it was accordingly moved to its present quarters. They are large and well lighted, facts which offset to some extent the disadvantage of being at a distance from the Metcalfe street building.

As said above, the principal work of the division consists in preparing plans for printing. These plans are compiled in the second and fourth divisions. In their compilation the main object is accuracy as to data; no special effort is made to form well made figures or letters, in fact the data are usually put on the plans in ordinary handwriting. In the third division these plans are copied, care being taken to make a neat, well arranged plan with all letters and figures carefully made. At present almost all the letters and figures are stamped on the plans in type, thus securing uniformity.

In 1906, a Pilot printing-press 6 x 10½ inches inside chase measurement was purchased in order to print titles, foot-notes, &c. When the use of a printing-press was first suggested for this work it was feared that it might not prove satisfactory; so in order not to have too large an outlay on what seemed a somewhat doubtful venture, the smallest and least expensive press was purchased. Two years' trial proved the press to be very useful and the results fully justified the expenditure, but it has been found to be scarcely large enough for some of the work required. The small press was therefore returned to the makers in part payment for a larger and better one 10 x 15 inches inside chase measurement. An expert printer is in charge; he also looks after all the type, ink, &c., used in connection with stamping plans. He has been kept so busy of late that a 'printer's devil' will doutless be his next requirement.

Another improvement in the office equipment consists in a larger and better tracing frame. It may be explained that a tracing frame is simply a device to enable the draughtsman to trace out on a blank sheet of paper any plan or drawing to be copied. The credit of designing the new tracing frame belongs largely to Mr. J. E. May. In the frame formerly in use sunlight was reflected so as to pass through the plan and make the lines visible to the draughtsman. There were two objections to this; the frame could not be used to advantage when the day was dark and clouded, and it had to be placed near a window in the best light which, of course, left less good light for the ordinary work of the draughtsmen. The present frame is lighted by a series of six electric lights placed below a sheet of plate glass. Provision is made for ventilating the space around these lights so as not to heat the glass. A hood of black cloth shuts out all light from the room and renders the artificial light more effective. Two slits along the edges of the frame make it possible to trace the largest plan by simply sliding the plan through them and rolling it up as it is traced.

During the year, 612 plans of townships have been prepared for printing, together with 167 plans and drawings of a miscellaneous nature. As indicated in the annual report of 1908 the miscellaneous plans and drawings are of great variety. A mere statement of their number gives no idea of the amount of work involved in their production.

With a view to ascertaining the cost of publication of township plans a statement of the actual time spent in preparing each township plan has been kept. This practice has been followed for about five years. Occasionally the cost of publishing plans of other descriptions has been called for and therefore a statement is now being kept of the time spent in preparing all plans and drawings.

DRAUGHTING OFFICE—FOURTH DIVISION—BRITISH COLUMBIA SURVEYS.

(E. L. Rowan-Legg.)

The staff of this division has been engaged in the examination of the returns of subdivision surveys, of mineral claims, of railway rights of way and of timber berths in the railway belt. Township and townsite plans for the British Columbia surveys are compiled and the fair copies of such plans for reproduction by photo-zincography

are compared. Instructions for surveys, together with sketches and other information for the use of surveyors in the field are prepared. Replies are made to requests for information, which frequently involves the preparation of sketches and long searches for data. Preliminary plans, which allow of lands being opened for entry previous to the issue of the official plan, are prepared for lands subdivided in the railway belt.

A large number of the returns of survey of timber berths in the railway belt were examined. The work of this division has been greatly increased, not only by the examination of these returns, which heretofore was made in another branch of this Department, but also by the drafting of letters and memoranda in connection therewith.

Discrepancies having been discovered in some of the old surveys in the vicinity of Kamloops lake, the compiling of the plans of several townships, which were urgently needed, could not be proceeded with until check surveys had been made to locate the cause of the discrepancies. As soon as possible, after the completion of these surveys, the plans were complied and copies issued.

A resurvey of the townsite of Hope was made by Mr. A. W. Johnson, D.L.S., in 1906, and a plan of the same was then commenced in this office, but could not be completed because it was found that some further surveys and corrections would be required. These were made by Mr. Johnson last year, and the plan was finished and copies were issued in January of this year.

On account of the rough character of the country in the railway belt a survey of the whole of any township is not proceeded with at one time, but section, or quarter section lines are surveyed to govern lands for which there are, or may be applications. All additional surveys which have been made since the issue of the first edition of the township plan are added to the original compiled plan, and copies are issued as a second, third or fourth edition corrected as the case may be.

The work of compiling plans of townships in the railway belt has been much complicated by having to show on them the lands which were disposed of by the Provincial Government, and which, therefore, did not form part of those transferred to the Dominion. As the boundaries of these lands do not coincide with section lines of the Dominion lands system of survey they have to be accurately plotted on the plan so as to allow of the areas of fractional legal subdivision of adjoining Dominion lands being shown. This adds greatly to the time spent in the work of compiling.

DRAUGHTING OFFICE—FIFTH DIVISION—MAPPING.

(J. Smith.)

The principal occupation of the fifth division is the interminable work of keeping the sectional maps up to date. These maps cover the surveyed area of the fertile belt of the northwest provinces from Lake of the Woods to the Rocky mountains and also the railway belt in British Columbia. Each sheet covers eight townships from south to north and an average of fourteen townships from east to west, thus comprising about one hundred and twelve townships or a little over four thousand square miles or two million five hundred and sixty thousand acres.

Up to the present time seventy-six sheets have been published and the number will be increased as the surveys are extended. No new sheets have been published during the past year but forty-six have been revised, thirty-four of these have been reprinted and the remainder are in the printers' hands and will be issued before long. Apart from the actual drawing and tracing of the sectional maps, a very considerable part of the work is the obtaining of the information required in revising. During the past year eight hundred and fifty-three plans of surveyed trails were obtained from the record office and examined for information, one hundred and fifty-five field books of township and other surveys were also obtained from the record office and used in compiling, besides two hundred and sixty-eight field books which had not yet been placed

on record. The positions of four hundred and twenty-seven post-offices were ascertained through the Post Office Department, and a large amount of information about new railways and other items had to be collected.

In connection with the Yukon surveys the number of returns received is more than double that of last year, and a more rigid scrutiny of the surveyors' returns has caused a great increase in the correspondence and in the office work generally.

The miscellaneous drawings made by the fifth division consist of a plan of the mouth of Klondike and Bonanza rivers showing the complication of surveys at that point, a small plan of a ford across the Athabaska river, a copy of W. Thibaudeau's plans and profiles of water-powers on the Winnipeg river, a plan of the electoral districts of Yukon Territory, plans of the first system of surveys near Prince Albert and the fifth system near Port Moody, a map of the boundary between the province of British Columbia and Yukon Territory from Teslin lake to Tatshenshini river, and a plan defining the foot of the eastern slope of the Rocky mountains from the international boundary to Peace river. The search for definite information on this last subject and a report thereon entailed the examination of one hundred and five field books, besides a large amount of other literature.

One draughtsman resigned his position since the last report but two others were appointed to the staff which now numbers eleven.

DRAUGHTING OFFICE—SIXTH DIVISION—SCIENTIFIC AND TOPOGRAPHICAL WORK.

(G. Blanchard Dodge.)

This division was formed during the year and is to consist of thirteen employees. The duties of the division will be the control and supervision of the scientific and topographical part of the surveys.

Almost from the inception of the surveys it has been realized that valuable topographical and scientific information could easily be obtained at a small extra cost by the surveyors who are subdividing Dominion lands. A few attempts were made to collect such information but from motives of economy they were soon discontinued, the work of the surveyors being strictly limited to what was necessary for the purposes of settlement. The value of such information being now better appreciated by the public, the surveys are being made somewhat more elaborate.

As a beginning, surveyors of base lines are now taking levels along the lines. These will be ultimately connected, and will form the basis for maps showing the relief of the country. A knowledge of this relief is of the utmost importance in questions of irrigation or drainage, construction of roads, railways or canals, for the classification of agricultural lands and many other purposes.

The field notes of the surveyors contain much topographical information which has never been plotted because the office staff was insufficient; this work will now be taken up and put in shape for publication.

Although the lines of the Dominion Lands System of survey are established upon astronomical bearings, the compass is very useful in exploratory surveys and for work of a like character. Considerable information is gathered by surveyors regarding the declination, inclination and intensity, but the observations have to be co-ordinated and properly recorded. Improvements in the instruments supplied to surveyors will greatly add to the value of the observations.

The preparation of the astronomical field tables and diagrams and the calculations incidental to the business of the topographical surveys have now assumed such proportions that a special staff of mathematical experts has become a necessity. Work of this character will all be done in this division.

SURVEY RECORDS OFFICE.

(C. J. Steers.)

The rapid increase in the routine work of the office has made it very difficult to get the time needed for readjustment of indexes and general supervision. During the months of the year when work was not so pressing some progress was made on the new loose leaf indexes. The portions being entered first are those which experience has shown most required adjustment.

A new index for field notes of township surveys has also been started and is being worked at as time is available. This index is made necessary as the old one is very congested owing to the smallness of its scale and the increasing numbers of field books affecting many of the townships.

A large portion of one man's time has been taken up supplying information for the sub-agents, chiefly in preparing for them skeleton maps of sub-agencies on a large scale showing the lands disposed of.

The increase in the number of printed and preliminary plans has been so great that it has been found necessary to divide up the work of sending them out; one person now attends to the printed plans and letters while another has charge of the preliminary plans and letters accompanying them.

A list is now kept of plans asked for which are out of print, so that these plans may be sent to the parties desiring them as soon as the reprints are received.

PHOTOGRAPHIC OFFICE—*(Process Work).*

(H. K. Carruthers.)

After the clean copy of a plan has been completed it is handed over to the process photographer for reproduction. The plan is photographed on a wet plate and then printed on a zinc plate. From the zinc, the plan is transferred either to stone or to another zinc plate, according as it is to be printed on the flat bed or rotary offset press.

A new copying camera has been installed; it takes plates from 4 x 5 inches to 24 x 34 inches, while the largest size with the old camera was 17 x 20 inches. A great advantage of the new camera is that it is provided with very complete means of adjustment; this will improve not only the quality of the work but its accuracy.

Corrections to plans have hitherto been made mostly on the lithographic stones or zinc plates; they are now being made as much as possible on the negatives, before printing on zinc. It is found that the corrections are not only more easily made on the negatives, but the work is also finer. The only extra trouble is the striking of a proof from the negative on blue print paper.

The number of negatives made was about 200 in excess of last year.

PHOTOGRAPHIC OFFICE—*(General Work).*

(John Woodruff.)

During dark days in winter some difficulty has been experienced in handling the large number of silver prints which we were called upon to furnish. To expedite printing, an aristo-electric lamp and cabinet have been procured. The cabinet is revolving; it holds forty 5 x 7-inch frames and twelve 11 x 14-inch frames. In the centre is a powerful arc lamp. The apparatus is a great convenience and there is no longer any delay in printing.

A dry mounting press has been purchased. With it photographs can be mounted on the thinest mounts without curling. The improvement is particularly manifest in the case of large photographs.

A considerable part of the chief photographer's time is taken by the work of the Immigration Branch. In this connection, he made two trips during the summer, one to the Niagara district for photographing farms and orchards, and one to the Ontario oil fields for photographing oil wells and plants. He secured a large collection of fine views. He also attended the Tercentenary celebration at Quebec and secured views of the most interesting events.

LITHOGRAPHIC OFFICE.

(A. Moody.)

The rotary offset press mentioned in the annual report for 1907-8 has been installed and is now in operation. It has given some trouble but it is expected that all the difficulties will soon be overcome and that it will be turning out fine work. It is a fast press and particularly useful in printing large editions.

The machine for graining zinc plates set up at the same time as the rotary press is proving quite satisfactory. By using zinc instead of lithographic stones, plans or maps can be kept on the plates for new issues, the plates being easily stored away. If the plans or maps were on stone, they would have to be cleared away after printing.

A lithographic artist has been added to the staff; when not engaged in preparing lithographic stones or plates, he helps in spotting and making corrections on negatives.

Part of the plant is in the building at the corner of Metcalfe and Slater streets, the other part being in the Imperial building. This division is very inconvenient; moreover, the places are too small and too crowded for working to advantage.

GEOGRAPHIC BOARD.

(A. H. Whitcher.)

The seventh report of the Geographic Board of Canada, being a consolidation of the decisions published in previous reports and bulletins to June 30, 1908, was published and distributed. In addition to the large number issued in 'blue book' form with other sessional papers of the Government, the Board receives 800 copies which are sent to Dominion and Provincial officials, colleges, school inspectors and libraries, also to geographical societies and map publishers in Canada and elsewhere, and the bulletins containing the decisions published in the *Canada Gazette* are distributed from time to time in like manner.

The regular monthly meetings of the Board have been well attended and special meetings have been held during the year.

Mr. Whitcher, who is a member of the Board and its secretary, has also continued the special work assigned to him as a member of the staff of the Topographical Surveys Branch.

BOARD OF EXAMINERS FOR DOMINION LAND SURVEYORS.

(F. D. Henderson.).

Three meetings of the Board of Examiners were held during the year. The first was a special meeting lasting from May 2 to May 28, 1908, during which examinations were held at Ottawa, Toronto, and Calgary. The second one was a special meeting held on July 28, 1908. The third one was the regular annual meeting which began on the second Monday in February, 1909 (February 8), as provided by the Dominion Lands Surveys Act, section 9, and lasted until March 26, 1909. During this meeting examinations were held at Ottawa, Halifax, Toronto, Winnipeg, Calgary, Edmonton and Vancouver.

At the two examinations (May, 1908, and February, 1909), eighty-eight candidates passed the preliminary examination, thus becoming eligible to serve as articled pupils, twenty-seven candidates passed the final examination for commission as Dominion land surveyor, and one candidate passed the examination for certificate as Dominion topographical surveyor. The names of the successful candidates are as follows:—

PRELIMINARY EXAMINATION.

Barnes, F. M., St. John, N.B.
Banting, E. W., Toronto, Ont.
Beale, A. M., Ottawa, Ont.
Bennett, G. A., Eden, Ont.
Beresford, H. E., Grandview, Man
Berry, E. W., Seaforth, Ont.
Bidouze, P., Edmonton, Alberta.
Blanchet, G. H., Ottawa, Ont.
Boulton, W. J., Wallaceburg, Ont.
Bowman, H. D., London, Ont.
Brown, E. C., Grenfell, Sask.
Buchanan, J. A., Comber, Ont.
Calder, J. A., Ashcroft, B.C.
Cameron, A., Ottawa, Ont.
Cannell, H. W., Ottawa, Ont.
Casey, J. M., Ottawa, Ont.
Churchill, H. W., Westport, N.S.
Cline, C. G., East Aurora, N.Y.
Colter, A. A., Keswick, N.B.
Dann, E. M., London, Ont.
Dawson, F. J., Truro, N.S.
de la Condamine, C., High River, Alta.
Donnelly, C., Winnipeg, Man.
Duff, M. O'R., Hamilton, Ont.
Elder, P. M., Ottawa, Ont.
Evans, S. L., Corinth, Ont.
Ewart, D. M., Ottawa, Ont.
Fletcher, J. A., Fletcher, Ont.
Glover, A. E., Beaverton, Ont.
Graham, D. A., Toronto, Ont.
Gray, J. E., Uxbridge, Ont.
Hamilton, C. T., Fort William, Ont.
Harvey, D. W., London, Ont.
Higgins, C. J., Vancouver, B.C.
Hobbs, W. E., Winnipeg, Man.
Huffman, K., Toronto, Ont.
Jackson, W., Toronto, Ont.
Johnson, R. H., Toronto, Ont.
Johnston, H. F., Toronto, Ont.
Jost, L. G., Guysborough, N.S.
Lloyd, N. C. A., Schomberg, Ont.
Loucks, R. W. E., Delisle, Sask.
Macdonald, G. A., Muirkirk, Ont.
Manny, D. E., Beauharnois, P.Q.
Martindale, E. S., Kingsmill, Ont.
Martin, W. H., St. Thomas, Ont.

Martyn, O. W., Mitchell, Ont.
Meader, C. H., Toronto, Ont.
Mitchell, A. B., Toronto, Ont.
Munro, F. V., Chatham, Ont.
Murdock, C. R., Toronto, Ont.
McCusker, K. F., St. Louis de Gonzague, P.Q.
McGarry, P. J., Merritton, Ont.
McKenzie, M., Lake Megantic, P.Q.
McLean, D. L., Ottawa, Ont.
McMaster, W. A. A., Palmerston, Ont.
McRoberts, A. A., Pontypool, Ont.
Narraway, A. N., Ottawa, Ont.
Neelands, R., Hamiota, Man.
Neville, E. A., Toronto, Ont.
Patterson, E. B., Toronto, Ont.
Peckover, H. J., Toronto, Ont.
Peters, F. H., Ottawa, Ont.
Pounder, J. A., Toronto, Ont.
Purser, R. C., Windsor, Ont.
Ransom, J. T., Toronto, Ont.
Redfern, C. R., Toronto, Ont.
Ritson, C. W., Edmonton, Alberta.
Robertson, E. D., Ottawa, Ont.
Robinson, W. A., Winnipeg, Man.
Roe, B. J., Ottawa, Ont.
Seibert, F. V., Southampton, Ont.
Sharpe, G. P., Agassiz, B.C.
Soars, N., Edmonton, Alberta.
Stewart, N. C., Nelson, B.C.
Stirrett, G. P., Petrolia, Ont.
Tate, H. W., Wimbledon, Eng.
Tremblay, A. J., Edmonton, Alberta.
Theriault, L. L., Fredericton, N.B.
Underwood, J. A., Lakelet, Ont.
Van Skiver, L. A., Fish Lake, Ont.
Walcott, W. H., Montreal, P.Q.
Walker, C. M., Guelph, Ont.
Warren, J. S., Strathcona, Alberta.
Waugh, B. W., Chicago, Ill.
Wilson, W. S., Sault Ste. Marie, Ont.
Wing, D. O., Berlin, Ont.

FINAL EXAMINATION.

Ashton, A. W., Ottawa, Ont.
Baker, M. H., St. Thomas, Ont.
Campbell, A. J., Toronto, Ont.
Campbell, A. S., Kingston, Ont.
Chilver, H. L., Walkerville, Ont.
Christie, U. W., Ottawa, Ont.
Clunn, T. H. G., Ottawa, Ont.
Cochrane, M. F., Ottawa, Ont.
Cumming, A. L., Ottawa, Ont.
Cummings, A., Fernie, B.C.

Dennis, E. M., Ottawa, Ont.
Dodge, G. B., Ottawa, Ont.
Johnson, P. N., Edmonton, Alberta.
Lang, J. L., Toronto, Ont.
McCallum, G. H., Ottawa, Ont.
McCaw, R. D., Welland, Ont.
McFarlane, J. B., Toronto, Ont.
Rannie, J. L., Ottawa, Ont.
Rice, F. W., Ottawa, Ont.
Rolfson, O., Walkerville, Ont.
Scott, W. A., Galt, Ont.
Summers, G. F. Winchester Ont.
Sykes F. H., Toronto, Ont.
Tremblay, A., Quebec, P.Q.
Westland, C. R., Ottawa, Ont.
Williams, G. L., Vancouver, B.C.
Wilson N. D., Toronto, Ont.

D. T. S. EXAMINATION.

McColl, G. B., Winnipeg, Man.

Oaths of office and allegiance and bonds for the sum of one thousand dollars each, as required by section 25 of the Dominion Lands Surveys Act, were received from twenty-five candidates who had previously passed the examination for commission as Dominion land surveyor.

Twenty-three commissions as Dominion land surveyors were issued, as follows:—

Ashton, A. W., Ottawa, Ont.
Baker, M. H., St. Thomas, Ont.
Campbell, A. S., Kingston, Ont.
Christie, U. W., Chesley, Ont.
Clunn, T. H. G., Ottawa, Ont.
Cochrane, M. F., Ottawa, Ont.
Dodge, G. B., Ottawa, Ont.
Lang, J. L., Toronto, Ont.
McAuslan, H. J., Euphrasia, Ont.
McCaw, R. B., Welland, Ont.
McFarlane, J. B., Toronto, Ont.
Mitchell, B. F., Hamilton, Ont.
Rannie, J. L., Ottawa, Ont.
Rinfret, C., St. Stanislas, P.Q.
Robinson, E. W. P., Victoria, B.C.
Rolfson, O., Walkerville Ont.
Scott, W. A., Galt, Ont.
Soars, H. M. R., Edmonton, Alberta.
Steele, I. J., Ottawa, Ont.
Stewart, A. S., Edmonton, Alberta.
Sykes, F. H., Toronto, Ont.
Williams, G. L., Vancouver, B.C.
Wilson, N. D., Toronto, Ont.

A certificate as Dominion topographical surveyor was issued to G. B. McColl, D.L.S., Winnipeg, Manitoba.

Every Dominion land surveyor is required to have in his possession a subsidiary standard of length (D.L.S. Act, section 35). Eighteen such standards were issued by the Secretary, and one surveyor reported that he had secured a standard from the estate of a deceased surveyor. A list of surveyors who have been furnished with standard measures up to March 31, 1909, will be found in Appendix No. 11.

The correspondence of the Board was as follows:—

Letters received	1,717
Letters sent	1,196

Circular letters, pamphlets and parcels sent, 600 (approx).

The questions put at the examination in February, 1909, are submitted in Appendix No. 12.

At the special meeting in May, 1908, 62 candidates presented themselves for the full preliminary examination, 15 for the limited, 18 for the final, and 1 for the examination for certificate as Dominion topographical surveyor. The affidavits and certificates of the final candidates were examined and the answers of all the candidates were read.

The meeting of July 28 dealt with a communication to the Board relative to a survey in the Yukon Territory.

At the regular meeting in February, 1909, 126 candidates presented themselves for the full preliminary examination, 21 for the limited preliminary, 34 for the final, and 2 for the D.T.S. The affidavits and the certificates of the final candidates were examined and the answers to the examination papers were read. Several communications were dealt with, and it was decided that when a surveyor obtains a standard measure from any one except the Secretary, he shall at once submit it to the Secretary to be tested.

Applications having been received from several candidates for an examination in May, the necessary question papers were prepared before adjournment.

The number of candidates examined during the year was 279 as compared with 161 during the previous year.

Mr. F. D. Henderson is the Secretary of the Board.

APPENDICES.

The following schedules and statements are appended:—

No. 1. Schedule of surveyors employed and work executed by them from April 1, 1908 to March 31, 1909.

No. 2. Schedule showing for each surveyor employed from April 1, 1908, to March 31, 1909, the number of miles surveyed, of township section lines, township outlines, traverses of lakes and rivers and resurvey; also the cost of the same.

No. 3. List of lots in the Yukon Territory, surveys of which have been received from April 1, 1908, to March 31, 1909.

No. 4. List of miscellaneous surveys in the Yukon Territory returns of which have been received from April 1, 1908, to March 31, 1909.

No. 5. Statement of work executed in the office of the chief draughtsman.

No. 6. List of new editions of sectional maps issued from April 1, 1908, to March 31, 1909.

No. 7. Statement of work executed in the survey records office from April 1, 1908, to March 31, 1909.

No. 8. Statement of work executed in the photographic office from April 1, 1908, to March 31, 1909.

No. 9. Statement of work executed in the lithographic office from April 1, 1908, to March 31, 1909.

No. 10. List of employees of the Topographical Surveys Branch at Ottawa giving the name, classification, duties of office and salary of each.

No. 11. List of Dominion land surveyors who have been supplied with standard measures.

No. 12. Examination papers of the board of examiners for Dominion land surveyors.

Nos. 13 to 50. Reports of surveyors employed.

No. 51. Descriptions of surveyed townships submitted by Dominion land surveyors from April 1, 1908, to March 31, 1909.

MAPS.

The following maps accompany this report:—

Map showing surveys and resurveys made from April 1, 1908, to March 31, 1909.
Map of the boundary between British Columbia and Yukon Territory.
Maps accompanying reports of surveyors.

I have the honour to be, Sir,
Your obedient servant,

E. DEVILLE,
Surveyor General.

TOPOGRAPHICAL SURVEYS BRANCH.

SCHEDULES AND STATEMENTS.

APPENDIX No. 1.

SCHEDULE of Surveyors employed and work executed by them, from April 1, 1908, to March 31, 1909.

Surveyor.	Address.	Description of Work.
Aylsworth, C. F.	Madoc, Ont..	Partial subdivision of township 22, range 4; retracement and restoration survey of townships 16, range 1, and 11, range 7; partial retracement and restoration of townships 12, range 5; 16, range 7, and 17, range 8; all east of the principal meridian. Retracement and restoration survey of township 18, range 3, west of the principal meridian.
Baker, J. C..	Vermilion, Alta..	Contract No. 7 of 1908; subdivision of townships 53, 55, and 56, range 14, townships 52, 53, and 55, range 15, and townships 52, ranges 16 and 17; the northerly one-third of townships 54, ranges 14 and 15, and the southerly one-third of township 53, range 16, also the east outline of township 56, range 16; all west of the fifth meridian.
Beatty, David..	Parry Sound, Ont.. ..	Survey of the east and south boundaries of Porcupine forest reserve in townships 39, ranges 29, 30, 31 and 32, township 40, range 28, and township 41, range 27, west of the principal meridian.
Belanger, P. R. A....	Ottawa, Ont..	Completion of inspection of contract No. 27 of 1906; inspection of contracts Nos. 14, 26, 30 and 32 of 1907, and partial inspection of contracts Nos. 17 and 20 of 1908; traverse of Winnipeg river in townships 13 and 14, ranges 12 and 13, and in townships 15 and 16, ranges 14 and 15; traverse of Pinawa channel in township 14, range 12; traverse of islands and lakes and verification surveys in townships 15, ranges 14 and 15; all east of the principal meridian.
Bingham, E. R..	Fort William, Ont....	Survey of a parcel of land between blocks A and B of The Pas Indian reserve and extending southerly a distance of one mile from the Saskatchewan river.
Bolton, Lewis..	Listowel, Ont..	Contract No. 2 of 1908; subdivision of townships 31 and 32, ranges 14, 15 and 16, and townships 28, 29, 30, 31 and 32, range 17; all west of the fourth meridian.
Bourgault, C. E..	St. Jean Port Joli, P.Q.	Retracement and correction surveys in townships 11, 19 and 20, range 2; 9 and 30, range 3; 9, range 4; 21 and 22, range 5; 14, range

APPENDIX No. 1—*Continued.*

SCHEDULE of Surveyors employed, and work executed by them, from April 1, 1908, to March 31, 1909—*Continued.*

Surveyor.	Address.	Description of Work.
		9; 17, 20 and 21, range 13; 20 and 21, range 14; 16, range 15, and 29, range 17; survey of Doukhobor village in township 31, range 3; retracement of township 20, range 4, and partial retracement of townships 21 and 23, range 8; all west of the second meridian. Partial retracement of township 16, range 28, west of the principal meridian.
Bourgeault, A..	St. Jean Port Joli, P.Q.	Contract No. 5 of 1908; complete subdivision of townships 20, ranges 8 and 9, and partial subdivision of township 18, range 11: all east of the principal meridian.
Bray, Edgar..	Oakville, Ont..	Contract No. 6 of 1908; subdivision of township 38, range 2; partial subdivision of townships 38, ranges 1 and 3; the east outlines of townships 39 and 40, ranges 2 and 3, and traverse of lakes, in township 37, range 2; all west of the second meridian.
Carson, P. A..	Ottawa, Ont..	Triangulation surveys in British Columbia in connection with the Trigonometrical Section of the Topographical Survey of Canada. Subdivision and traverse in townships 26 and 27, range 26, west of the fifth meridian.
Cautley, R. H.... ..	Edmonton, Alta..	Contract No. 13 of 1908; subdivision of townships 5 and 6, ranges 4, 5, 6 and 7; townships 7, 8 and 9, ranges 3, 4, 5 and 6; townships 10, ranges 3 and 6, and townships 6, ranges 2 and 3; all west of the third meridian.
Cautley, R. W..	Edmonton, Alta..	Contract No. 29 of 1908; completion of subdivision of townships 31, range 15; 32, range 18, and 34, range 19: subdivision of townships 31, range 16; 32, ranges 15, 16 and 17; 33, ranges 16, 17 and 18, 34, range 18, and 35, ranges 18, 19 and 20; partial resurvey of township 34, range 20; traverses in townships 30 and 31, range 17, and 33, range 19; survey of the east outlines of townships 36, ranges 20 and 21; all west of the principal meridian.
Christie, Wm..	Chesley, Ont..	Survey of portions of the seventh base across ranges 9 and 10; resurvey of the eighth base across ranges 11 and 12; resurvey of the ninth base across ranges 15, 16, 17 and parts of ranges 14 and 18; retracement of the ninth base across ranges 10, 11, 12, 13 and part of 14; survey of the east outlines of townships 29, 30 and part of 31, range 10; 31 and 32, range 16, and 33, 34, 35 and 36, range 17; all west of the principal meridian.
Coté, J. L..	Edmonton, Alta..	Contract No. 21 of 1908; subdivision of townships 64, ranges 19 and 20, township 66, range 18, and townships 67, ranges 16, 17, 19, 20, 21, 22 and 23; survey of the east outlines of townships 63, ranges 19 and 20, townships 65, 66 and 68, range 17, and of townships 65 and 68, range 18; all west of the fourth meridian.

APPENDIX No. 1—*Continued.*

SCHEDULE of Surveyors employed, and work executed by them, from April 1, 1908, to March 31, 1909—*Continued.*

Surveyor.	Address.	Description of Work.
Davies, T. A..	Ottawa, Ont..	Retracement of the fifth meridian from the northeast corner of section 24, township 4, to the third base; partial retracement of townships 5, 6, 7 and 8, range 1; partial subdivision of townships 8, 9, 10, 12 and 13, range 3, and of township 8, range 4; all west of the fifth meridian. Partial retracement of townships 5, 6, 7, 8 and 9, range 30, and township 9, range 29; all west of the fourth meridian.
Deans, W. J..	Brandon, Man..	Part subdivision of townships 23, ranges 20 and 21, townships 29 and 30, range 23, township 26, range 24, and township 23, range 26; miscellaneous retracement and correction surveys in townships 23, range 10, 22 and 23, range 11, 28, range 18, 30 and 31, range 21, 22, range 27, and 24, range 30, west of the principal meridian.
Driscoll, A.. .. .. .. (*See* A. G. Stacey.)	Edmonton, Alta..	Contract No. 8, 1908; subdivision of townships 1 and 2, ranges 2, 3 and 4, townships 3, ranges 7, 8 and 9; townships 4 and 5, ranges 2, 3, 7, 8 and 9; survey of the east outlines of townships 3, ranges 2, 3, 4 and 5; all west of the fourth meridian.
Dumais, P. T. C.. ..	Hull, Quebec..	Contract No. 33 of 1907; subdivision of townships 27, 28 and 29, ranges 12 and 13, and township 30, range 13; all west of the principal meridian.
Edwards, Geo..	Ponoka, Alta..	Contract No. 25 of 1908; subdivision of townships 52, ranges 7 and 8; partial subdivision of townships 52, range 9; all west of the fifth meridian.
Fairchild, C. C..	Edmonton, Alta..	Contract No. 16 of 1908; subdivision of townships 61, ranges 6 and 7, townships 62, ranges 4, 5, 6 and 7; partial subdivision of township 62, range 1; survey of the east outlines of townships 63 and 64, ranges 4, 5, 6, 7 and 8; all west of the fifth meridian. Partial subdivision of township 62, range 27, west of the fourth meridian.
Farncomb, A. E.. ..	Lacombe, Alta..	Contract No. 12 of 1908; subdivision of townships 52, ranges 21, 22, 23 and 24, townships 53, ranges 21, 22 and 23; all west of the fifth meridian.
Fawcett, A..	Gravenhurst, Ont.. ..	Contract No. 26 of 1908; subdivision of townships 50, 51 and 52, ranges 12 and 13, and township 50, range 14; survey of east outline of township 49, range 12; all west of the second meridian.
Fawcett, T..	Niagara Falls..	Retracement and restoration survey of the fourth meridian through townships 6 to 26 inclusive. Miscellaneous surveys in townships 10 and 11, range 22, west of the fourth meridian; miscellaneous surveys in townships 12 and 28, range 1, 50, range 6, 35, range 13, 14 and 15, range 24, and 14, range 30; all west of the third meridian. Miscel-

APPENDIX No. 1—*Continued.*

SCHEDULE of Surveyors employed, and work executed by them, from April 1, 1908, to March 31, 1909—*Continued.*

Surveyor.	Address.	Description of Work.
		laneous surveys in townships 23 range 13, 25 range 22, 50 range 26, and 41 range 27; all west of the second meridian.
Fontaine, L. E..	Lévis, Que..	Inspection of contracts Nos. 29 and 31 of 1907, and completion of the inspection of contracts Nos. 2, 16 and 24 of 1907; inspection of contracts Nos. 7, 18 and 27 of 1908; miscellaneous surveys in townships 55, range 5, and 57, range 7, west of the fifth meridian.
Green, T. D..	Ottawa, Ont..	Survey of the east outlines of townships 43 and 44, ranges 19 and 20, west of the fifth meridian; a traverse to locate coal lands on the south branch of Brazeau river.
Hawkins, A. H..	Listowel, Ont..	Survey of the twelfth base across ranges 15 to 19 inclusive; survey of the thirteenth base across ranges 24 to 28 inclusive; partial subdivision of township 49, range 27; survey of the east outline of township 50 and part of east outline of township 49, range 27; all west of the fifth meridian; survey of the thirteenth base across part of range 1, west of the sixth meridian.
Heathcott, R. V... .. .	Edmonton, Alta..	Contract No. 28 of 1908; subdivision of townships 55 and 56, ranges 12 and 13, and partial subdivision of townships 54, ranges 12 and 13; all west of the fifth meridian. Contract No. 31 of 1907; subdivision of townships 52 and 53, ranges 18, 19 and 20, west of the 5th meridian.
Holcroft, H. S..	Toronto, Ont	Subdivision of townships 81, ranges 24, 25 and 26, and township 82, range 24; resurvey of the east outline of township 82, range 24, and of the north outlines of townships 80, ranges 24, 25 and 26; all west of the fifth meridian; resurvey of the sixth meridian through township 81; survey of an addition to Shaftsbury settlement.
Hopkins, M. W..	Edmonton, Alta..	Contract No. 19 of 1908; subdivision of townships 61, 62 and 63, range 1, townships 61, 62, 63 and 64, range 2, townships 61 and 62, ranges 3, 4, 7, 8, 9 and 10; survey of the east outlines of townships 63 and 64, ranges 8 and 10; all west of the fourth meridian.
Hubbell, E. W..	Ottawa, Ont..	Inspection of contracts Nos. 6, 7, 11, 13, 27 and 28 of 1907, and contracts Nos. 6 and 11 of 1908; completion of inspection of contracts Nos. 15, 20 and 21 of 1907; mounding the east boundary of townships 39 and 40, range 17, and correction survey in township 39, range 16, west of the second meridian; traverse in township 52, range 4, west of the third meridian.
Johnson, A. W..	Kamloops, B.C..	Subdivision in townships 5 and 12, range 27, west of the sixth meridian, and in township 21, E.C.M.; resurvey in townships 7, 8, 9 and 11, range 22, in townships 5, 7, 8, 6, 9, 10, 11 and 12, range 23, west of the sixth

APPENDIX No. 1—*Continued.*

SCHEDULE of Surveyors employed, and work executed by them, from April 1, 1908, to March 31, 1909—*Continued.*

Surveyor.	Address.	Description of Work.
		meridian, and in township 26, E.C.M.; traverse survey in township 5, range 26, and in township 14, range 27, west of the sixth meridian; subdivision and resurvey in township 2, range 29, west of the sixth meridian, and in townships 3 and 4, range 5, west of seventh meridian; traverse and resurvey in townships 12, 13 and 16, E.C.M.; traverse and subdivision in townships 6 and 7, range 26, west of the sixth meridian; traverse, subdivision and resurvey in township 15, range 27, and townships 3, ranges 29 and 30, west of the sixth meridian; two triangulations from the Canadian Pacific railway to the boundary of the railway belt.
Kimpe, M.	Edmonton, Alta.	Contract No. 18 of 1908; subdivision of townships 49, 50 and 51, range 7, and townships 55 and 56, ranges 9, 10 and 11, and completion of the subdivision of township 54, range 11; all west of the fifth meridian.
Kirk, J. A.	Revelstoke, B.C.	Partial subdivision of townships 23, ranges 2 and 5, west of the sixth meridian.
Kitto, F. H.	Ottawa, Ont.	Contract No. 11 of 1908; subdivision of townships 52, ranges 3 and 4, west of the third meridian.
Knight, R. H.	Edmonton, Alta.	Contract No. 14 of 1908; subdivision of townships 61, 62 and 63, ranges 23 and 24, and township 65, range 24; all west of the fourth meridian.
Lonergan, G. J.	Buckingham, Que.	Inspection of contracts Nos. 4 and 34 of 1907, and of contracts Nos. 2, 10, 14, 16, 21 and 23 of 1908; restoration surveys in townships 54 and 55, ranges 20 and 21, and miscellaneous surveys in township 62, range 12, township 61, range 13, townships 52, ranges 15 and 16, townships 64 and 65, range 21, township 50, range 26, and townships 51, ranges 25, 26 and 27; all west of the fourth meridian. Miscellaneous surveys in township 59, range 4, west of the fifth meridian.
McFarlane, W. G.	Toronto, Ont.	Contract No. 1 of 1908; subdivision of townships 7, 8, 9 and 10, ranges 7, 8, 9, 10, 11 and 12, and townships 5 and 6, range 8; survey of the east outlines of townships 5 and 6, ranges 10, 11, 12 and 13; all west of the third meridian.
McFee, A.	Red Deer, Alta.	Survey of the boundaries of Buffalo Park reserve through townships 42 and 43, range 6, 42, 43 and 44, ranges 7 and 8, and township 43, range 9, west of the fourth meridian.
McGrandle, H.	Wetaskiwin, Alta.	Contract No. 10 of 1908; subdivision of townships 60, ranges 19, 20, 21 and 22, township 59, range 21, and part of township 60, range 18; all west of the fourth meridian.

APPENDIX No. 1—*Continued.*

SCHEDULE of Surveyors employed, and work executed by them, from April 1, 1908, to March 31, 1909—*Continued.*

Surveyor.	Address.	Description of Work.
McMillan, Geo..	Ottawa, Ont..	Resurvey of township 49, range 25, west of the second meridian; resurvey of townships 42, 43 and 44, range 1, west of the third meridian, including a resurvey of St. Laurent settlement; partial resurvey of township 35, range 5, west of the third meridian.
Miles, C. F.	Toronto, Ont..	Inspection of contracts Nos. 1, 3, 8, 9, 13 and 15 of 1908; retracement and restoration survey of townships 23, ranges 1 and 4, and townships 24, ranges 2, 3 and 4; miscellaneous surveys in townships 23, range 2, and 18, range 14; all west of the third meridian; miscellaneous surveys in township 1, range 12, township 19, range 29, and township 18, range 30; all west of the second meridian.
Molloy, John..	Winnipeg, Man..	Contract No. 24 of 1908; subdivision of townships 9 and 10, ranges 14, 15 and 16, and township 10, range 13; all east of the principal meridian.
Montgomery, R. H.. .	Prince Albert, Sask.. .	Miscellaneous surveys in townships 43 and 44, range 8, 43, range 9, 48, range 13, and 51, ranges 14 and 15, west of the third meridian, and in township 42, range 24, west of the second meridian. Contract No. 4 of 1908; subdivision of townships 51 and 52, ranges 14 and 15, townships 51, ranges 16, 17 and 18, and partial subdivision of township 50, range 14; all west of the second meridian.
Morrier, J. E..	Ottawa, Ont..	Survey of Churchill townsite.
Ord, L. R..	Calgary, Alta..	Contract No. 30 of 1908; subdivision of townships 32, range 7, 31 and 32, range 8, 30 and 31, range 9, and townships 29, 30 and 31, range 10; survey of the east outlines of townships 29, range 9, and 32, range 11; all west of the principal meridian.
Plunkett, T. H..	Salmon Arm, B.C.. ..	Partial subdivision of townships 26, range 19, 26 and 27, range 21, 26 and 28, range 22, 28, range 23, 21, range 27, and township 21, range 28, west of the fifth meridian; partial subdivision of township 23, range 2, west of the sixth meridian; partial subdivision and resurvey of township 25, range 28, west of the fifth meridian; traverse in township 27, range 22, and township 20, range 29, west of the fifth meridian; traverse in township 20, range 1, west of the sixth meridian.
Ponton, A. W..	Macleod, Alta..	Survey of the fifth meridian from township 85 to township 107 inclusive.
Reilly, Wm. R..	Regina, Sask..	Retracement and restoration survey in townships 46, ranges 21 and 22, townships 47a, ranges 24 and 25, and township 49, range 23; partial retracement and restoration survey of townships 45 and 49, range 21, townships 44, 45 and 49, range 22, and townships 46, ranges 23 and 24; traverse in township 42, range 27; all west of the second meridian.

APPENDIX No. 1—*Continued.*

SCHEDULE of Surveyors employed, and work executed by them, from April 1, 1908, to March 31, 1909—*Continued.*

Surveyor.	Address.	Description of Work.
Robinson, E. W..	Chase, B.C..	Partial subdivision of township 23, range 5, townships 21 and 23, range 7, and township 22, range 8; traverse survey in township 23, range 4; subdivision and traverse in township 23, range 2; subdivision and resurvey in township 22, range 6; traverse, subdivision and resurvey in township 23 range 6, and township 22, range 7; all west of the sixth meridian.
Ross, Jos. E..	Kamloops, B.C..	Partial subdivision in townships 20 and 21, range 12, townships 16 and 23, range 22, townships 20 and 21, ranges 23 and 24, and township 18, range 25; partial resurvey of townships 18 and 19, range 17, and townships 21, ranges 20 and 21; traverse, subdivision and resurvey in township 18, range 16, townships 19, ranges 12, 14, 15, 16 and 24, townships 20, ranges 13, 15, 16, 19 and 21, and township 22, range 17; subdivision and traverse in township 15, range 22, township 16, range 26, township 19, range 13, township 20, range 21, and township 23, range 23; subdivision and resurvey in township 20, range 14, township 22, range 21, and townships 17, 18 and 19 ,range 25; all west of the sixth meridian.
Roy, Geo. P..	Quebec..	Contract No. 27 of 1908; subdivision of townships 57, ranges 10 and 11, and township 58, range 11; all west of the fifth meridian.
Saint Cyr, A..	Ottawa, Ont..	Survey of the sixth meridian through townships 52, 51, 48 and part of 47; survey of the fifteenth base west of the fifth meridian across ranges 24, 23, 22, 21 and part of range 20.
Saint Cyr, J. B..	Montreal..	Subdivision of townships 80, ranges 3 and 4; survey of the east outlines of townships 77, 78 and 79, range 5, the south outline of township 79, range 3, and the north outline of township 78, range 4; all west of the sixth meridian; survey of Dunvegan settlement in township 80, range 4, west of the sixth meridian, and of an addition to Peace River Landing settlement in township 83, range 21, west of the fifth meridian.
Saunders, B. J..	Edmonton, Alta..	Survey of the eleventh base through ranges 8 to 18 inclusive, and part of range 19, west of the fifth meridian.
Selby, H. W..	Toronto, Ont..	Subdivision of townships 73 and 74, range 10, and township 74, range 13; partial subdivision of townships 72, ranges 3, 5, 6, and 10, townships 73, ranges 4, 5, 6, and 11, township 74, range 9, township 80, range 19, and townships 81, ranges 19 and 20; survey of the east outline of township 73, range 13, and part of the east outline of township 74, range 12; all west of the fifth meridian; retracement of the Hudson's Bay Company reserve at Lesser Slave lake.

APPENDIX No. 1—*Continued.*

SCHEDULE of Surveyors employed, and work executed by them, from April 1, 1908, to March 31, 1909—*Continued.*

Surveyor.	Address.	Description of Work.
Seymour, H. L.	Edmonton, Alta.	Contract No. 29 of 1907; subdivision of townships 44 and 47, range 4, townships 48 and 49, range 5, and township 49, range 6; partial resurvey of township 43, range 4; survey of the east outlines of townships 45 and 46, range 5; all west of the fifth meridian. Contract No. 22 of 1908: subdivision of townships 45 and 46, ranges 4, 5 and 6; survey of the east outlines of township 47, range 6, and townships 47 and 48, range 7; all west of the fifth meridian.
Stacey, A. G. (Deceased, balance of contract performed by A. Driscoll, D.L.S.)	Ottawa, Ont.	Contract No. 8 of 1908; subdivision of townships 4 and 5, ranges 4 and 5; all west of the fourth meridian.
Steele, I. J.	Ottawa, Ont.	Contract No. 15 of 1908: subdivision of townships 1, 2, 3 and 4, ranges 19, 20, 21 and 22, townships 2 and 3, ranges 23, 24, 25 and 26, and township 2, range 27; survey of the east outlines of townships 1, ranges 24, 25, 26, 27 and 28, and the south outlines of townships 1, ranges 23, 24, 25, 26 and 27; partial resurvey of the south outline of township 1, range 18; all west of the second meridian.
Talbot, A. C.	Calgary, Alta.	Survey of villa lots at lake Minnewanka; survey of a road from Laggan to lake Louise; partial subdivision of township 28, range 16, west of the fifth meridian.
Teasdale, C. M.	Concord, Ont.	Contract No. 26 of 1907; subdivision of townships 27 and 28, ranges 10 and 11, west of the principal meridian. Contract No. 20 of 1908; subdivision of townships 25, ranges 3, 4, 5, 6 and 7, and township 26, range 7: all west of the principal meridian.
Thibaudeau, W.	Ottawa, Ont.	Preliminary exploration and hydro-topographic surveys St. Mary, Waterton, Southfork and Crowsnest rivers, and on Oil Pass and Tib creeks; preliminary explorations on Belly, Oldman and Livingstone rivers, and on Pincher, Lee, Mills, Gold and Blairmore creeks.
Tyrrell, J. W.	Hamilton, Ont.	Contract No. 17 of 1908; subdivision of townships 25 and 28, range 1, east of the principal meridian; subdivision of townships 25, 26, 27 and 28, range 1, and townships 25, 26, and 27, range 2; survey of east outlines of township 28, range 3; all west of the principal meridian.
Waddell, W. H.	Hamilton, Ont.	Contract No. 23 of 1908; subdivision of townships 63 and 64, range 13, townships 63, 64 and 65, ranges 14 and 15; all west of the fourth meridian.
Waldron, John.	Moosejaw, Sask.	Contract No. 3 of 1908; subdivision of townships 4, 5, 6 and 7, range 20, townships 5, ranges 21 and 22, townships 5 and 6, range 23, townships 1, 2, 3 and 4, ranges 26 and 27, and townships 2, 3 and 4, range 30; com-

APPENDIX No. 1—*Continued.*

SCHEDULE of Surveyors employed, and work executed by them, from April 1, 1908, to March 31, 1909—*Continued.*

Surveyor.	Address.	Description of Work.
		pletion of subdivision of townships 6 and 7, ranges 21 and 22; all west of the third meridian; subdivision of townships 1, 2, 3, 4 and 5, range 1, west of the fourth meridian.
Wallace, J. N..	Calgary, Alta..	Survey of the Yukon-British Columbia boundary from Tatshenshini river to Takhini river.
Warren, Jas..	Walkerton, Ont..	Resurvey of the fourth base across ranges 2, 3 and 4; partial subdivision of township 13, range 2, townships 11, 12 and 13, range 3, townships 10 and 11, range 4, and townships 22 and 23, range 5; traverse in township 14, range 1; all west of the fifth meridian.
Watt, Geo..	Ottawa, Ont..	Contract No. 9 of 1908; subdivision of townships 1, 2, 3, 8 and 9, range 13, townships 8, ranges 14 and 15, townships 4, 5 and 7, ranges 16 and 17, townships 4, 5, 6 and 7, ranges 18 and 19; partial subdivision of townships 7, ranges 13, 14 and 15; survey of the east outlines of township 4, range 13, and townships 6, ranges 16 and 17; all west of the third meridian.
Wheeler, A. O..	Calgary, Alta..	Examination and classification of the lands undisposed of in the railway belt, British Columbia, above and below Revelstoke, above and below Golden and in the vicinity of Shuswap lake.
Wiggins, T. H..	Saskatoon, Sask..	Correction survey in township 34, range 9, west of the third meridian.
Young,, W. H..	Lethbridge, Alta.. .. .	Partial subdivision of township 4, range 1, township 6, range 2, townships 5, 6 and 7, range 3, and township 7, range 4; all west of the fifth meridian; partial subdivision of township 3, range 30, and traverse in townships 11, ranges 22 and 23; all west of the fourth meridian.

APPENDIX No. 2.

SCHEDULE showing for each surveyor employed from April 1, 1908, to March 31, 1909, the number of miles surveyed of township section lines, township outlines, traverses of lakes and rivers and resurvey, also cost of same.

Surveyor.	Miles of section lines.	Miles of outlines.	Miles of traverse.	Miles of resurvey.	Total mileage.	Total cost.	Cost per mile.	By day work or by contract.
						$ cts.	$ cts	
Aylsworth, C. F	.....	.....	5·30	270·50	275·80	9,855 09	35 73	Day.
Baker, J. C	421·38	62·32	82·23	.....	565·93	16,024 84	28 31	Contract.
Beatty, David	.....	.....	52·50	.....	52·50	6,733 00	128 24	Day.
†Belanger, P. R. A	.....	.....	87·11	5·50	92·61	13,386 35	.....	"
Bingham, E. R	.....	.....	5·31	.....	5·31	282 90	53 28	"
Bolton, Lewis	514·65	.....	44·08	.....	558·73	4,286 63	7 67	Contract.
Bourgault, C. E	.....	.....	26·05	334·75	360·80	9,063 96	25 12	Day.
Bourgeault, A	94·34	10·08	10·50	.....	114·92	3,363 16	29 26	Contract.
Bray, Edgar	106·00	30·00	5·50	.....	141·50	4,381 27	30 96	"
Cautley, R. H	1,148·60	50·20	42·33	.....	1,241·13	9,441 66	7 60	"
Cautley, R, W	359·88	31·28	368·58	.....	759·74	12,773 40	16 81	"
Christie, Wm	10·00	52·00	.....	64·50	126·50	7,310 57	57 79	Day.
Côté, J. L	532·92	73·46	140·83	.....	747·21	19,980 71	26 74	Contract.
Davies, T. A	62·00	.....	.....	58·50	120·50	10,273 17	85 25	Day.
Deans, W. J	33·00	.....	16·80	127·50	177·30	8,000 00	45 12	"
*Driscoll, A	880·79	90·84	117·52	.....	1,089·15	8,880 35	8 15	Contract.
Dumais, P. T. C	162·90	17·00	60·02	.....	239·92	5,861 82	24 43	"
Edwards, Geo	133·10	18·09	30·01	.....	181·20	5.058 37	27 91	"
Fairchild, C. C	348·63	113·56	131·14	.....	593·33	16,959 50	28 58	"
Farncomb, A. E	340·12	42·19	77·81	.....	460·12	12,361 24	26 86	"
Fawcett, Adam	316·21	42·20	51·46	.....	409·87	10,957 21	26 73	"
Fawcett, Thos	.....	.....	14·55	171·75	186·30	4,466 78	23 98	Day.
†Fontaine, L. E	.....	.....	7·00	12·00	19·00	12,679 62	.....	"
Green, T. D	1·00	24·00	4·32	.....	29·32	4,200 00	143 24	"
Hawkins, A. H	8·00	65·50	.....	.....	73·50	13,500 00	183 67	"
Heathcott, R. V	516·59	56·34	180·66	.....	753·59	19,485 37	25 85	Contract.
Holcroft, H. S	163·75	24·00	72·16	27·25	287·16	14,688 63	51 15	Day.
Hopkins, M. W	779·23	70·29	259·05	.....	1,108·57	27,364 48	24 68	Contract.
†Hubbell, E. W	.....	.....	3·95	.....	3·95	12.628 23	.....	Day.
Johnson, A. W	20·00	.....	70·00	90·00	180·00	14,733 43	81 85	"
Kimpe, M	451·21	32·68	27·33	.....	511·22	15,334 43	29 99	Contract.
Kirk, J. A	4·04	.....	3·61	7·00	14·65	344 10	23 48	Day.
Kitto, F. H	86·72	.....	29·11	.....	115·83	2,989 01	25 80	Contract.
Knight, R. H	336·15	35·96	42·71	.....	414·82	11,842 63	28 55	"
†Lonergan, G. J	.....	.....	34·40	206·75	241·15	12,319 35	.....	Day.
McFarlane, W. G,	1,260·81	88·13	.....	.....	1,348·94	10,137 27	7 51	Contract.
McFee, A	.....	.....	69·50	.....	69·50	1,300 00	18 70	Day.
McGrandle, Hugh	248·45	.....	21·30	.....	269·75	7,045 59	26 12	Contract.
McMillan, Geo	.....	.....	96·75	221·00	317·75	10,714 79	33 72	Day.
†Miles, C. F	.....	.....	8·00	265·00	273·00	11,492 51	.....	"
Molloy, John	476·80	42·66	.....	.....	519·46	15,418 30	29 68	Contract.
Montgomery, R. H	.....	.....	19·25	8·25	27·50	828 20	30 11	Day.
Montgomery, R. H	379·18	18·09	33·70	.....	430·97	12,706 92	29 48	Contract.
Morrier, J. E	.....	.....	66·12	.....	66·12	5,339 04	80 74	Day.
Ord, L. R	228·62	30·08	64·44	.....	323·14	7,512 99	23 25	Contract.
Plunkett, Thos, H	33·96	.....	34·77	5·00	73·73	9,270 11	125 73	Day.
Ponton, A. W	.....	138·00	.....	.....	138·00	10,925 00	79 17	"
Reilly, Wm. R	.....	.....	154·34	242·50	396·84	8,817 98	22 22	"
Robinson. E. W	22·01	.....	47·98	1·94	71·93	12,000 00	166 83	"
Ross. Jos. E	116·32	.....	68·09	31·20	215·61	11,274 80	52 29	"
Roy, Geo. P	139·12	.....	1·50	.....	140·62	4,262 33	30 31	Contract.
Saint Cyr, A	.....	47·50	.....	.....	47·50	15,000 00	315 79	Day.
Saint Cyr, J. B	115·00	20·00	55·60	.....	190·60	10,450 00	54 82	"
Saunders, B. J	.....	67·50	.....	.....	67·50	15,100 00	223 70	"
Selby, H. W	255·25	52·90	67·72	.....	375·87	12,505 00	33 27	"
Seymour, H. L	514·48	66·94	32·16	.....	613·58	16,510 01	26 90	Contract.
*Stacey, A. G	181·42	12·06	.....	.....	193·48	1,574 59	8 13	"
Steele, I. J	1,287·55	125·03	114·14	.....	1,527 72	10,809 58	7 07	"
Talbot, A. C	2·00	.....	8·00	.....	10·00	667 75	66 77	Day.
Teasdale, C. M	462·74	30·07	75·85	.....	568·66	14,978 77	26 34	Contract.
Tyrrell, J. W	511·22	23·59	5·77	.....	540·58	15,996 50	29 59	"
Waddell, W. H	375·22	.....	106·73	.....	481·95	12,304 99	25 53	"
Waldron, John	1,260·51	118·59	2·93	.....	1,382·03	10,931 49	7 91	"
Wallace, J. N	.....	.....	36·80	.....	36 80	15,530 09	422 01	Day.
Warren, Jas	77·50	8·00	18·00	19·00	122·50	9,308 77	75 99	"
Watt, Geo. H	1.125·15	173·50	5·75	.....	1,304·40	10,829 20	8 30	Contract.
Wiggins, T. H	.....	.....	.....	3·50	3·50	65 00	18 57	Day.
Young, W. H	79·90	13·00	4·49	2·00	99·39	9,000 00	90 55	"
	16,984·42	2,018·63	3,323·61	2,175·39	24,502·05	681,418 74		

*Mr. A. G. Stacey, D.L.S., died and the contract was completed by A. Driscoll, D.L.S., with the same party. † Inspector of contract surveys.

APPENDIX No. 3.

LIST of Lots in the Yukon Territory, survey returns of which have been received from April 1, 1908, to March 31, 1909.

GROUP No. 1.

Lot No.	Area in Acres.	Surveyor.	Year of Survey.	Date of Approval.	Claimant.	Remarks.
41	68·1	C. S. W. Barwell	1908	*.....	Albert P. Shulze...	Surface.

GROUP No. 2.

N 1	0·363	James Gibbon..	1907	June 10, 1908..	....	Surface.
K24	.....	C. W. MacPherson	1908	*.....	White Channel Gold Hill Hydraulic Co., Ltd.	"
180	46·2	C. S. W. Barwell	1908	*.....	Capt. T. H. Alcock	Riverview M. C.
375	51·6	" ..	1908	Feb. 23, 1908..	Ernest Sleuter..	New Hope M. C.
376	51·6	" ..	1908	Nov. 11, 1908..	Lizzie Olivia Craig.....	Iron Duke M. C.
377	51·6	" ..	1908	" 11, 1908..	"	Black Prince M. C.
378	51·6	" ..	1908	" 11, 1908..	"	Belle M. C.
378	.... ..	" ..	1908	*.....	N. A. T. & T. Co.....	Klondike Lode M. C
380	51·3	" ..	1908	Nov. 11, 1908..	Lizzie Olivia Craig.....	Chas. L. M. C.
387	640·0	C. W. MacPherson	1907	*.....	Dept. of Indian Affairs.....	Indian Reserve.
389	20·85	James Gibbon..	1908	Sept. 11, 1908..	John Nicholas.....	Tacoma M. C.
392	51·3	C. S. W. Barwell	1908	Nov. 11, 1908..	Lizzie Olivia Craig...	Walter D. M. C.
393	51·6	" ..	1908	" 11, 1908..	"	Thelma M. C.
394	51·6	" ..	1908	" 11, 1908..	"	Lottie M. C.
395	45·9	" ..	1908	*.....	N. A. T. & T. Co..... .	Klondike Lode Ext'n No. 1 M. C.
396	32·73	James Gibbon..	1908	Sept. 11, 1908..	Margaret J. Mitchell *et al.* .	Comstock M. C.
398	51·65	" ..	1908	" 11, 1908..	Jane S. Orrell.....	Silver Knight M. C.
400	47·5	C. S. W. Barwell	1908	Oct. 2, 1908..	Emil Mohr.	Edna M. C.
401	11·5	" ..	1908	*.....	N. A. T. & T. Co.....	Surface.
402	11·5	" ..	1908	*.....	"	"
403	51·0	" ..	1908	*.....	"	Klondike Lode Ext'n No. 3 M. C.
404	50·5	" ..	1908	*.....	L. Schmidt.....	An Curd M. C.
405	51·6	" ..	1909	*.....	Thos. Mulcahey *et al*.....	Dunsmuir M. C.
406	51·6	" ..	1909	*.....	"	Bald Eagle M. C.
407	51·6	" ..	1909	*.....	"	Black Jack M. C.

GROUP No. 4.

B 3	11·24	C. W. MacPherson	1908	Oct. 3, 1908..	The English Church Missions	Surface.

* Not yet approved.

APPENDIX No. 3.—*Continued.*

LIST of Lots in the Yukon Territory, survey returns of which have been received from April 1, 1908, to March 31, 1909.—*Continued.*

GROUP No. 5.

Lot. No.	Area in Acres.	Surveyor.	Year of Survey.	Date of Approval.	Claimant.	Remarks.
110	51·55	H. G. Dickson..	1907	*.....	A. B. Palmer	Centre Star M. C.
111	46·37	" ..	1907	*.....	"	Papoose M. C.
112	49·14	" ..	1907	*.....	"	Morning M. C.
113	30·35	" ..	1907	*.....	"	Mack M. C.
115	45·56	" ..	1908	*.....	Wm. Clark	Verona M. C.
121	0·77	N.A.Burwash.	1908	Sept. 25, 1908..	F. R. Alley.....	Flora M. C.
122	13·15	" ..	1908	" 25, 1908..	"	Alma M. C.
123	9·88	" ..	1909	" 25, 1908..	"	Midget M. C.
124	2·09	" ..	1908	" 25, 1908..	"	Flora No. 2 M. C.
125	49·07	" ..	1908	" 25, 1908..	W. S. Thomas	Copper Chief M. C.
126	39·58	" ..	1908	" 25. 1908..	"	Copper Nugget M.C.
127	138·67	" ..	1908	Oct. 17, 1908..	L. E. Belney and Karl Weik	Manitou Copper M.C
128	49·48	" ..	1908	" 17, 1908..	W. S. Thomas	Kluane M. C.
129	48·91	" ..	1908	" 17, 1908..	"	Little Johnnie M.C.
130	31·62	" ..	1908	" 17, 1908..	"	Overland M. C.
131	3·98	" ..	1908	Sept. 25, 1908..	"	Corsair M. C.
132	47·58	" ..	1908	Oct. 17. 1908..	L. E. Belney and Karl Weik	Grover M. C.
133	51·65	" .	1908	July 15, 1908..	W. S. Thomas.....	Paragon M. C.
134	48·17	" ..	1908	Sept. 25, 1908..	"	Ora M. C.
135	47·08	" ..	1908	" 25, 1908..	"	Alvia M. C.
136	44·74	" ..	1908	July 15, 1908..	"	Little Frank M. C.
137	51·65	" ..	1908	" 15, 1908..	"	I.O.U.M.C.
138	51·65	" ..	1908	" 15, 1908..	"	I. and E.M.C.
139	51·38	" ..	1908	" 15, 1908..	"	Reta M. C.
140	51·63	" ..	1908	" 15, 1908..	"	Bernice M.C.
141	51·49	" ..	1908	" 15, 1908..	"	York M. C.
143	45·94	" ..	1908	" 8, 1908..	"	Helena M. C.
144	17·58	" ..	1908	" 8, 1908..	"	Florence M. C.
145	31·02	" ..	1908	" 8, 1908..	"	Iron Horse M. C.
146	13·74	" ..	1908	" 8, 1908.	S.C. Barrington.....	Carnage M. C.
148	47·03	" ..	1908	" 8, 1908..	W. S. Thomas	Rothsay, M. C.
149	39·24	" ..	1908	Sept. 28, 1908..	"	Autumn M. C.
150	12·02	" ..	1908	July 7, 1908..	"	Sour Dough M. C.
154	28·48	H.G. Dickson..	1908	June 29, 1908..	E. A. Dickson.....	Dick M. C.
155	45·77	" ..	1908	" 29, 1908..	Paul Jameson.....	Hope M. C.
156	51·65	" ..	1908	*.....	William Maher.....	Copper Cliff M. C.
157	11·35	" ..	1908	March 2, 1909..	C. H. Johnson.....	Mabel Extension Frac'n M. C.
176	33.65	N.A.Burwash..	1908	July 15, 1908..	W. S. Thomas	Pueblo Star No. 2 M. C.
177	1·37	" ..	1908	Sept. 25. 1908..	W. L. Forrest.	Flora No. 3 (Fractional) M. C.
178	16.46	" ..	1908	" 25, 1908..	K. Weik.....	Dawson M. C.
179	14·00	" .	1908	Feb. 2, 1909..	P. F. Scharsehmidt	Surface.
180	21·91	" ..	1908	Oct. 2, 1908..	A. B. Palmer	Prudence M. C.
181	6·36	" ..	1908	" 2, 1908..	"	Pocahauntus M. C.

* Not yet approved.

APPENDIX No. 3.—*Continued.*

LIST of Lots in the Yukon Territory, survey returns of which have been received from April 1, 1908, to March 31, 1909.—*Concluded.*

GROUP No. 6.

Lot No.	Area in Acres.	Surveyor.	Year of Survey.	Date of Approval.	Claimant.	Remarks.
20	50·44	H. G. Dickson..	1907	*.	J. H. Conrad.....	Venus M.C.
21	51 13	" ..	1907	*.....	"	Venus No. 2 M.C.
22	11·12	" ..	1907	*.....	"	Venus Fraction M.C.
24	3·52	" ..	1907	*..... ...	"	Mars M.C.
25	51·08	" ..	1907	*.	"	M. & M.M.C.
26	21·48	" ..	1907	*.....	"	Vault M.C.
27	51·65	" ..	1907	*.....	"	Uranus M.C.
28	50·83	" ..	1907	*.....	"	Uranus No. 2 M.C.
29	23·02	" ..	1907	*.....	"	Cappella M.C.
30	44·31	" ..	1907	*.....	"	Joe Petty M.C.
31	46·75	" ..	1907	*.....	"	Little Johnny M.C.
32	32·58	" ..	1907	June 24, 1908..	"	Reliance M.C.
33	51·65	" ..	1907	*....	"	Black Jack M.C.
34	51·65	" ..	1908	Jan. 19, 1909..	"	Montana M.C.
35	50·94	" ..	1908	" 19, 1909..	"	Mountain Hero M.C.
36	51·16	" ..	1907	*.....	"	Monarch M.C.
37	42·10	" ..	1908	Jan. 19, 1909..	"	Commander M.C.
38	36·09	" ..	1908	" 19, 1909..	"	Jumbo M.C.
39	35·03	" ..	1908	" 19, 1909..	"	O. K. M.C.
40	37·33	" ..	1908	*.....	W. P. Granger.	Lake Shore M.C.
41	10·15	" ..	1908	Jan. 19, 1909..	J. H. Conrad.....	Fox M.C.
42	17·45	" ..	1908	" 19, 1909..	"	Mountain Lion M.C.
43	35·97	" ..	1908	" 19, 1009..	"	Elephant M.C.
44	51·65	" ..	1907	Apr. 24, 1908..	"	4th of July M.C.
45	50·11	" ..	1907	" 19, 1908..	"	Gurteen M.C.
46	43·86	" ..	1907	*.....	"	Empress M.C.
47	40·01	" ..	1907	*.....	"	Princess No. 2 M.C.
48	45·84	" ..	1907	*.....	"	T. & B. M.C.
49	40·80	" ..	1907	*.....	"	Sunrise M.C.
50	39·62	" ..	1907	*.....	"	Sunset M.C.
51	35·75	" ..	1907	*.....	"	Thistle M.C.
52	41·01	" ..	1907	*.....	"	Rose M.C.
53	6·61	" ..	1907	*.....	"	Fair Play M.C.
55	40·21	" ..	1907	*.....	"	Aurora M.C.
56	51·65	" ..	1907	*.....	"	Glacial Lake M.C.
57	19·15	" ..	1907	*.....	"	Columbian M.C.
58	24·21	" ..	1907	*.....	"	Westover M.C.
59	8·98	" ..	1908	Jan. 19, 1909..	"	Mamouth M.C.
61	51·65	" ..	1907	*.....	"	Caribou M.C.
62	51·55	" ..	1907	*.....	"	Pride of Yukon M.C.
63	47·48	" ..	1907	*.....	"	Pride of Yukon No. 2 M.C.
64	40·16	" ..	1907	*.....	"	Jupiter M.C.
65	51·64	" ..	1907	*..	"	Lone Jack M.C.
66	44·79	" ..	1907	*....	"	Chesley M.C.
67	47·67	" .	1907	*.....	"	Eureka M.C.
68	47·42	" .	1907	*.....	"	Eureka No. 2 M.C.
69	9·04	" ..	1907	*.....	"	Nipper M.C.
70	49·65	" ..	1907	*.....	"	Royston M.C.
71	42·90	" ..	1907	*.....	"	Pedro M.C.
72	24·80	" ..	1907	*.....	"	Vega M.C.
73	29·29	" ..	1907	*..... ...	"	Vanguard M.C.
74	29·14	" ..	1907	*.....	"	Dawson M.C.
75	49·86	" ..	1907	*..	"	Bellajara M.C.
76	34·69	" ..	1907	*..... ..	"	Annex M.C.
77	79·91	" ..	1907	Mar. 2, 1909..	"	Surface
78	14·00	" ..	1908	*..	J. M. Pooley & J. M. Stewart	Maybelle (Fraction) M.C.
98	48·89	" ..	1907	*..	Jas. C. Grace	Washington M.C.
99	51·65	" ..	1908	*.....	Laura Hill.....	Legal Tender M.C.
100	50·40	" ..	1908	*..... . ..	E. M. Morgan.....	Azurite M.C.
101	47·74	" ..	1908	*.	"	Malachite M.C.
102	49·83	" ..	1908	*.....	"	Cromwell M.C.

*Not yet approved.

APPENDIX No. 4.

List of Miscellaneous Surveys in the Yukon Territory, returns of which have been received from April 1, 1908, to March 31, 1909.

Year.	Surveyor.	Description of Survey.
1901	P. T. C. Dumais.....	Glacier creek base line (part of) a tributary of Gold creek.
1901	"	Moose creek base line (part of) a tributary of Fortymile river.

APPENDIX No. 5.

STATEMENT of work executed in the office of the chief draughtsman:—

Letters of instruction to surveyors	225
Progress sketches received and filed	1,308
Declarations of settlers received and filed	436
Returns of separate blocks of timber berths received	300
Plans received from surveyors	503
Field books received from surveyors	750
Timber reports received	276
Observations for magnetic declination received	11
Preliminary township plans prepared	492
Sketches made	2,163
Maps and tracings made	342
Plans of Yukon lots received	154
Plans of miscellaneous Yukon surveys received	6
Tracings of Yukon survey plans made	163
Yukon lots reduced to 40 chains to 1 inch and plotted on group plans	242
Yukon traverses reduced to 40 chains to 1 inch and plotted on group plans	8
Returns of surveys examined—	
Township subdivision	501
Township outline	370
Road plans	280
Railway plans	76
Mineral claims	17
Timber berths	213
Correction and other miscellaneous surveys	105
Township plans compiled	692
Townsite settlement and other plans compiled	14
Proofs of plans examined	487
Township plans printed	609
Townsite and settlement plans printed	14
Descriptions written	9
Pages of field notes copied	463
Applications for various information dealt with	2,034
Files received and returned	2,124
Letters drafted	6,476
Books received from record office and used in connection with office work	5,237
Books returned to record office	6,136
Plans other than printed township plans received from record office and used in connection with office work	1,038
Plans returned to record office	1,061
Volumes of plans received from record office and used in connection with office work	93
Volumes of plans returned to record office	105
Books sent to record office to be placed on record	615
Plans other than township plans sent to record office to be placed on record	429

APPENDIX No. 5 -*Continued.*

STATEMENT of work executed in the office of the chief draughtsman—*Continued.*

Sectional maps (3 miles to 1 inch)—	
Revised	46
Reprinted	34
New drawings of old worn out sheets	1
New tracings of old worn out sheets	8
Sectional maps (6 miles to 1 inch)—	
Reprinted	11
Proofs of sectional sheets examined	47

APPENDIX No. 6.

List of new editions of sectional maps issued from April 1, 1908, to March 31, 1909.

[Scale 3 miles to 1 inch.]

No.	Name.	No.	Name.	No.	Name.	No.	Name.
18	Wood Mountain	72	Portage la Prairie	166	Sounding Creek	268	Carlton.
19	Willowbunch	114	Calgary	167	Bad Hills	269	Prince Albert S.
20	Souris	115	Blackfoot	169	Touchwood	270	Pasquia.
21	Turtle Mountain	116	Rainy Hills	170	Yorkton	271	Mossy Portage.
23	Emerson	117	Red Deer Forks	214	Rocky Mt. House	317	Fort Pitt.
24	Lake of the Woods	118	Rush Lake	217	Tramping Lake	318	Shell River.
64	Porcupine	119	Regina	218	Saskatoon	319	Prince Albert N.
69	Moosejaw	121	Riding Mountain	219	Humboldt		
70	Moose Mountain	123	Fort Alexander	221	Swan River		

[Scale 6 miles to 1 inch.]

22	Dufferin	215	Red Deer	265	Peace Hills	366	Saddle Lake.
164	Morley	216	Sullivan Lake	266	Ribstone Creek	416	La Biche.
168	The Elbow	264	Brazeau	267	Battleford		

APPENDIX No. 7.

STATEMENT of work executed in the survey records office from April 1, 1908, to March 31, 1909.

Files received and dealt with	15,078
Letters drafted	4,741
Reports, memos. to Council, drafts	1
Plans, tracings, &c., copied or compiled	742
Statutory declarations copied or mailed	407
Plans sent to agents, registrars, &c.	19,578
Pages of field notes copied	892
Prints of plans received and stored	179,725
Original plans received and recorded	1,238
Original field notes received and recorded	596
Letters written to agents	1,444
Registered parcels mailed	1,739

Work performed for the Topographical Surveys Branch.

Books searched for	7,552
Books sent	5,973
Books returned	6,775
Plans searched for	3,386
Plans sent	2,515
Plans returned	1,229
Volumes searched for	99
Volumes sent	69
Volumes returned	132

Work done for the Patents Branch.

Plans searched for	1,070
Plans sent	1,034
Plans returned	916
Field books searched for	83
Field books sent	82
Field books returned	37

Work done for other Branches.

Plans searched for	533
Plans sent	1,034
Plans returned	464
Field books searched for	360
Field books sent	352
Field books returned	424

APPENDIX No. 8.

STATEMENT of work executed in the photographic office from April 1, 1908, to March 31, 1909.

—	3¼ x 3¼	4 x 5	5 x 7	8 x 10	10 x 12	11 x 14	16 x 18	18 x 20	24 x 30	30 x 36	36 x 42	42 x 48	Total.
Dry plate negatives		316	848			48							1,212
Bromide prints		36	44	311	8	139	179	141	50	24	8	3	1,017
Vandyke prints				5	17	48	108	89	86	61	32	13	459
Silver prints		1,322	4,293	52		21	9						5,697
Lantern transparencies	390												390
Photographs mounted			468	46	1	67	93	10					685
Wet plate negatives				127		134	770	230					1,261
Photo litho plates								872					872
	390	1,674	5,653	541	100	457	1,159	1,342	136	85	40	16	11,593

APPENDIX No. 9.

STATEMENT of work executed in the lithographic office from April 1, 1908, to March 31, 1909.

MONTH.	MAPS.		TOWNSHIPS.		FORMS, &c.	
	No.	Copies.	No.	Copies.	No.	Copies.
1908.						
April	11	750	50	10,000	13	7,140
May	1	200	38	7,600	22	7,370
June	11	3,850	96	19,200	4	3,550
July	10	55,200	.....	.....	3	3,200
August	7	6,750	7	1,400	10	14,950
September	.....	.....	92	18,400	1	3,000
October	3	2,700	25	5,000	6	10,175
November	3	3,200	25	5,000	3	750
December	10	4,600	73	14,600	5	8,350
1909.						
January	10	4,725	105	21,000	....	.....
February	10	11,850	33	6,600	1	2,000
March	17	46,025	38	7,600	5	1,700
Total	93	139,850	582	116,400	73	62,185

RECAPITULATION.

—	No.	Copies.	Impressions.	Cost.
				$ cts.
Maps	93	139,850	305,317	2,659 28
Townships	582	116,400	118,400	4,493 04
Forms, &c.	73	62,185	70,735	975 68
Total	748	318,435	494,452	8,128 00

APPENDIX No. 10.

List of employees of the Topographical Surveys Branch at Ottawa, giving the name, classification, duties of office and salary of each.

(Metcalfe Street, Corner of Slater.)

Name.	Classification. Division	Sub-division.	Duties of Office.	Salary.
				$ cts.
Deville, E., D.T.S., LL.D.	1	A	Surveyor General	3,200 00
	CORRESPONDENCE.			
Brady, M.	1	B	Secretary	2,100 00
Cullen, M. J.	3	A	Stenographer	1,000 00
Moran, J. F.	3	B	Typewriter and clerk	550 00
Williams, E. R.	3	B	Correspondence clerk	600 00
Lynch, F.	3	B	Typewriter	700 00
Addison, W. G.	3	B	Typewriter	500 00
Paquette, A.	3	B	Clerk	700 00
Pegg, A.	.....	.....	Messenger	700 00
	ACCOUNTS.			
Hunter, R. H.	2	A	Accountant	1,800 00
Wilkinson, Percy	3	A	Asst. Accountant	900 00

Draughting Office.

General direction and supervision of the technical work.

Symes, P. B.	1	B	Chief draughtsman	2,100 00
Shanks, T., B.A.Sc., D.L.S.	1	B	Asst. chief draughtsman	2,100 00

APPENDIX No. 10—*Continued.*

Draughting Office—First Division.

Registration of Surveyors' plans, field notes and other documents; preparation of instructions to surveyors, annual and other reports; answering inquiries about surveys and preparing preliminary plans of townships.

Name.	Classification.		Duties of Office.	Salary.
	Division	Sub-division.		
				$ cts.
Brown, T. E., B.A.	1	B	Chief of division	2,100 00
Green, W. T., B.A., D.L.S.	2	A	Asst. chief of division.	1,600 00
Umbach, J. E., Grad. S.P.S., D.L.S.	2	A	" "	1,600 00
Barber, H. G., Grad. S.P.S., D.L.S.	2	A	" "	1,600 00
Rice, F. W., Grad. School of Mining, D.L.S.	2	A	" "	1,600 00
Belleau, J. A., D.L.S.	2	A	" "	1,600 00
McRae, A. D., B.A., B. Sc.	2	B	Draughtsman	1,100 00
Carroll, M. J., Grad. S.P.S.	2	B	"	1,300 00
Grant, A. W., B.A.	2	B	"	1,100 00
Peaker, W. J., Grad. S.P.S.	2	B	"	1,000 00
Grant, A. M., B. Sc.	2	B	"	1,000 00
Milliken, J. B., B.A., B. Sc.	2	B	"	1,000 00
MacMillan, J. P., B.E.	2	B	"	1,000 00
Cordukes, J. P., B. Sc.	2	B	"	900 00
Wadlin, L. N., B. Sc.	2	B	"	900 00
Hayward, H. E., B. Sc.	2	B	"	1,000 00
Sylvain, J.	2	B	"	1,450 00
Rochon, E. C.	2	B	"	1,100 00
McLaughlin, M. J.	2	B	"	1,100 00
Holbrook, C. H.	3	B	Clerk	700 00
Burkholder, E. L.	3	B	"	550 00

Draughting Office—Second Division.

Examining the returns of surveys in Manitoba, Saskatchewan and Alberta; plotting the plans of townships and checking the accounts for contract surveys.

Nash, T. S., Grad. S.P.S., D.L.S.	1	B	Chief of division	2,100 00
Henderson, F. D., Grad. S.P.S., D.L.S.	2	A	Asst. chief of division.	1,600 00
Burgess, E. L., Grad. S.P.S., D.L.S., O.L.S.	2	A	" "	1,600 00
Dennis, E. M., B. Sc., D.L.S.	2	A	" "	1,600 00
Elder, A. J., Grad. S.P.S., D.L.S.	2	A	" "	1,600 00
Hill, S. N., Grad. S.P.S.	2	A	" "	1,600 00
Elwell, Wm., Grad. S.P.S.	2	A	" "	1,600 00
Cumming, A. L., B. Sc., D.L.S.	2	A	" "	1,600 00
Sutherland, H. E., B. Sc.	2	B	Draughtsman	1,100 00
Robertson, D. F., Grad. S.P.S.	2	B	"	1,300 00
Clunn, T. H. G., D.L.S.	2	B	"	1,450 00
Kitto, F. H., D.L.S.	2	B	"	1,200 00
Bonnell, M.B., B.A. Sc.	2	B	"	1,000 00
Norrish, B. E., B. Sc.	2	B	"	900 00
McClennan, W. D.	2	B	"	1,350 00
Roger, A.	2	B	"	1,350 00
Spreckley, R. O.	2	B	"	1,200 00
Goodday, Leonard	2	B	"	1,100 00
Williamson, F. H. H.	2	B	"	1,100 00
Webb, G. C.	2	B	"	1,100 00
Bray, R. P.	2	B	"	1,100 00
Harrison, E. W.	2	B	"	1,000 00
Ault, H. W.	2	B	"	1,000 00
d'Orsonnens, A.	2	B	"	1,300 00
Stronach, R. S.	2	B	"	1,000 00
Macdonald, J. A.	3	B	Clerk	550 00
Vacant	2	B	Draughtsman	1,000 00
Vacant	2	B	"	1,000 00
Vacant	2	B	"	1,000 00

APPENDIX No. 10—*Continued.*

Draughting Office—Third Division.

(Imperial Building, Queen Street.)

Copying plans for reproduction.

Name.	Classification.		Duties of Office.	Salary.
	Division	Sub-division		
				$ cts.
Engler, Carl, B.A., D.L.S.	2	A	Chief of division	1,750 00
May, J. E.	2	A	Asst. chief of division	1,600 00
O'Connell, J. R.	2	B	Draughtsman	1,450 00
Moule, W. J.	2	B	"	1,350 00
Helmer, J. D	2	B	Clerk	800 00
Dawson, R. J.	2	B	"	800 00
Archambault, E.	2	B	"	800 00
Tremblay, A.	3	B	"	750 00
Brown, A.	3	B	"	650 00
Binks, C. R.	3	B	"	600 00
Ebbs, E. J	3	B	"	500 00
Watters, James	3	A	Printer	1,000 00
Vacant	3	B	Clerk	500 00

Draughting Office—Fourth Division.

(Metcalfe Street, Corner of Slater.)

Supervising British Columbia surveys; preparing instructions; examining the returns and plotting the plans of the surveys.

Rowan-Legg, E. L.	2	A	Chief of division	1,750 00
Gillmore, E. T. B., Grad. R. M. C.	2	A	Asst. chief of division	1,700 00
Lawe, H., D.L.S.	2	A	" "	1,600 00
MacIlquham, W. L., B.Sc.	2	A	" "	1,600 00
Morley, R. W.	2	A	" "	1,600 00
Weld, W. E.	2	A	" "	1,600 00
Wilson, E. E. D.	2	B	Draughtsman	1,400 00
Osmond, H	2	B	"	1,000 00
Harris, K. D	2	B	"	1,000 00

Draughting Office—Fifth Division.

(Imperial Building, Queen Street.)

Compiling sectional maps and township index.

Smith, J.	1	B	Chief of division	2,100 00
Begin, P. A.	2	A	Asst. chief of division	1,650 00
Genest, P. F. X.	2	A	" "	1,600 00
Lepage J. B.	2	A	Draughtsman	1,600 00
Blanchet, A. E.	2	B	"	1,450 00
Davies, T. E. S.	2	B	"	1,300 00
Perrin, V.	2	B	"	1,300 00
Davy, E.	2	B	"	1,100 00
Flindt, A. H.	2	B	"	1,000 00
Villeneuve, E.	2	B	"	800 00
Bergin, W.	2	B	"	800 00

APPENDIX No. 10—*Continued.*

DRAUGHTING OFFICE—SIXTH DIVISION.

(Imperial Building, Queen Street.)

PLOTTING topographical plans; examining and plotting returns of levels on base lines; calculating and recording barometric elevations and magnetic observations; calculating astronomical field tables; testing and adjusting survey instruments.

Name.	Classification.		Duties of Office.	Salary.
	Division	Sub-division		
				$ cts.
Dodge, G. B., D.L.S.	1	B	Chief of division	2,100 00
Vacant	2	B	Computer & draughtsman	1,000 00
Vacant	2	B	" "	1,000 00
Vacant	2	B	" "	1,000 00
Vacant	2	B	" "	1,000 00
Vacant	2	B	" "	1,000 00
Vacant	2	B	" "	1,000 00
Vacant	3	B	Clerk	500 00
Vacant	3	B	"	500 00
Vacant	3	B	"	500 00
Vacant	3	B	"	500 00
Vacant	3	B	"	500 00
Vacant	3	B	"	500 00

GEOGRAPHER'S OFFICE.

(Woods Building, Slater Street.)

White, James, F.R.G.S.	1	A	Chief Geographer	3,000 00
Chalifour, J. E.	1	B	" draughtsman	2,100 00
Baine, H. E.	2	A	Draughtsman	1,850 00
Taché, Henri	2	A	"	1,600 00
Anderson, W.	2	A	"	1,600 00
Bryant, E. D.	2	A	"	1,600 00
Inkster, Fred.	2	A	"	1,600 00
Beveridge, J.	2	A	"	1,600 00
Akerlindh, A.	2	B	"	1,250 00
Darrach, A. M.	2	B	"	1,100 90
Blatchley, H. M.	2	B	"	1,050 00
Dumouchel, G. E.	2	B	"	1,050 00
Grindlay, Thos.	2	B	"	1,200 00
Wilson, H. W.	2	B	"	1,050 00
Chandler, S.	2	B	"	1,000 00
Bennie, J.	2	B	"	1,000 00
Craig, R. W.	2	B	"	1,000 00
Groulx, A.	2	B	"	900 00
Gagnon, J. S.	2	B	"	900 00
McElligott, J. P.	2	B	"	800 00
Blue, W. A.	2	B	"	800 00
Pigeon, J. H.	2	B	"	800 00
Waine, Mrs. F. E.	3	B	Clerk	700 00
Martin, Miss, M. P.	3	B	Stenographer	600 00
Stewart, Miss M.	3	B	"	500 00
Merrifield, J. R.			Messenger	700 00
Vacant	2	B	Draughtsman	800 00

APPENDIX No. 10—*Continued.*

Survey Records Office.

(Canadian Building Slater Street.)

Name.	Classification. Division	Sub-division	Duties of Office.	Salary.
				$ cts.
Steers, C. J.	2	A	Clerk in charge	1,700 00
Currie, P. W., B.A., B.Sc., D.L.S.	2	A	First assistant	1,750 00
Surtees, W. S.	2	A	Clerk	1,600 00
Lecourt, Eugéne	2	B	Draughtsman	1,550 00
Ashton, A. W., D.L.S.	2	B	"	1,250 00
Gillis, W. C., B.Sc.	2	B	"	1,200 00
Brice, E. E.	2	B	"	1,000 00
Smith, F. W.	2	B	"	900 00
Sowter, T. W. E.	3	A	Clerk	1,100 00
Belleau, Eugène, B.L.	3	A	"	1,100 00
Lambart, O. H.	3	A	"	1,100 00
Yielding, Miss A. B.	3	A	"	1,100 00
Routh, C. T.	3	A	"	900 00
Moore, R. T.	3	B	"	700 00
Landry, Narcisse	3	B	"	600 00

Geographic Board.

(Woods Building, Slater Street.)

Whitcher, A. H., F.R.G.S., D.L.S.	2	A	Secretary	1,900 00

Photographic Office.

(Metcalfe Street, Corner of Slater Street.)

Carruthers, H. K.	2	A	Process photographer	1,600 00
Woodruff, John	2	A	Chief "	1,600 00
Whitcomb, H. E.	3	A	Photographer	1,000 00
Morgan, W. E.	3	A	"	900 00
Kilmartin, A.	3	B	Asst. photographer	800 00
Devlin, A.	3	B	"	800 00
Ouimet, E. G.	3	B	Clerk	700 00

Lithographic Office (Unclassified).

(Metcalfe Street, Corner of Slater.)

Name.	Occupation.	Salaries.
Moody, A.	Foreman	$25 00 per week.
Burnett, E.	Lithographer	25 00 "
Thicke, C. R.	"	22 00 "
Deslauriers, J. H.	Transferrer	20 00 "
Bergin, J.	Printer	18 00 "
Thicke, H. S.	"	18 00 "
Boyle, S.	Stone polisher	14 00 "
Gagnon, J.	Press feeder	11 00 "
Kane, P.	"	7 00 "

APPENDIX No. 11.

LIST of Dominion Land Surveyors who have been supplied with Standard Measures.

Name.	Address.	Date of Appointment.	Remarks.
Austin, G. F.	Dewdney, Alta.	April 14, 1872	
Aylen, J.	North Bay, Ont.	May 29, 1885	
Aylsworth, C. F.	Madoc, Ont.	" 13, 1886	
Baker, J. C.	Vermilion, Alta.	" 18, 1906	
Baker, M. H.	Maple Creek, Sask.	Aug. 6, 1908	
Barwell, C. S. W.	Dawson, Yukon Territory.	" 21, 1894	
Bayne, G. A.	Winnipeg, Man.	April 14, 1872	
Beatty, D.	Parry Sound, Ont.	" 14, 1872	
Beatty, W.	Delta, Ont.	" 14, 1872	
Belanger, P. R. A.	Ottawa. Ont.	May 17, 1880	Inspector of Surveys, Topographical Surveys Branch, Dept. of Interior.
Bellcau, J. A.	"	" 15, 1883	Topographical Surveys Branch, Dept. of Interior.
Bigger, C. A.	"	Mar. 30, 1882	Astronomer, Dept. of Interior.
Bingham, E. R.	Fort William, Ont.	Oct. 25, 1906	
Bolton, L.	Listowel, Ont.	April 14, 1872	
Boswell, E. J.	Not known	Mar. 18, 1903	
Bourgeault, A.	St. Jean Port Joli, Que.	" 29, 1883	
Bourgault, C. E.	" "	Feb. 21, 1888	
Bourget, C. A.	Levis, Que.	May 14, 1884	
Bowman, H. J.	Berlin, Ont.	Feb. 16, 1888	
Brabazon, A. J.	Ottawa, Ont.	May 13, 1882	
Brady, J.	Golden, B.C.	April 14, 1872	
Bray, S.	Ottawa, Ont.	Nov. 14, 1883	Dept. of Indian Affairs.
Bray, L. T.	Amherstburg, Ont.	Feb. 18, 1903	
Bridgland, M. P.	Calgary, Alta.	Mar. 10, 1905	Topog. Surveys Branch, Dept. of Interior.
Brownlee, J. H.	Victoria, B.C.	April 15, 1887	
Bucknill, W. B.	Vancouver, B.C.	Mar. 19, 1908	
Burke, W.	Minnedosa, Manitoba.	April 14, 1872	
Burnet, H.	Ottawa, Ont.	June 22, 1885	
Burwash, N. A.	Whitehorse, Yukon Territory.	Mar, 6, 1907	
Burwell, H. M.	Vancouver, B.C.	Feb. 17, 1887	
Campbell, A. S.	Kingston, Ont.	Mar. 6, 1909	
Carbert, J. A.	Medicine Hat, Alta.	May 12, 1880	
Carpenter, H. S.	Regina, Sask.	Feb. 20, 1901	Dept. of Public Works for Saskatchewan.
Carroll, C.	Prince Albert, Sask.	April 14, 1872	
Carson, P. A.	Ottawa, Ont.	Feb. 22, 1906	Topog. Surveys Branch, Dept. of Interior.
Cautley. R. H.	Edmonton. Alta.	May 1, 1905	
Cautley, R. W.	"	Sept. 2, 1896	
Cavana, A. G.	Orillia, Ont.	Nov. 16, 1876	
Charlesworth, L. C.	Edmonton, Alta.	Mar. 24, 1903	Dept. of PublicWorks, Alberta.
Chilver, C. A.	Walkerville, Ont.	Feb. 22, 1907	
Christie, W.	Chesley, Ont.	Mar. 22, 1906	
Coates, P. C.	Golden, B.C.	April 19, 1907	
Cleveland, E. A.	Vancouver, B.C.	June 27. 1899	
Côté, J. A.	Prince Albert, Sask.	May 14, 1884	
Côté, J. L.	Edmonton, Alta.	Mar. 21, 1890	
Cotton, A. F.	New Westminster, B.C.	May 11, 1880	
Craig, J. D.	Ottawa, Ont.	Feb. 24, 1902	Boundary Surveys, Dept. of Int.
Cummings, A.	Fernie, B.C.	Mar. 3, 1909	
Cummings, J. G.	Calgary, Alta.	Feb. 17, 1904	
Dalton, J. J.	Weston, Ont.	April 17, 1879	Dominion Topographical Surveyor.
Davies, T. A.	Ottawa, Ont.	Feb. 22, 1906	
Deans, W. J.	Brandon, Man.	May 13, 1886	
Dennis, J. S.	Calgary, Alta	Nov. 19, 1877	Dominion Topographical Surveyor, Inspector of Irrigation and British Columbia Land Commissioner, C.P.R.

APPENDIX No. 11—*Continued.*

List of Dominion Land Surveyors who have been supplied with Standard Measures—*Continued.*

Name.	Address.	Date of Appointment.	Remarks.
Denny, H. C	Not known	April, 1, 1882	
Dickson, H. G	Whitehorse, Yukon Territory	Mar. 19, 1899	
Dickson, J	Fenelon Falls, Ont	April, 14, 1872	
Dobie, J. S	Regina, Sask	Mar. 22, 1906	Dept. of Public Works for Saskatchewan.
Doupe, J	Winnipeg, Man	April, 14, 1872	
Doupe, J. L	"	Oct. 6, 1888	Asst. Land Commissioner, C. P.R.
Drewry, W. S	New Denver, B.C	Nov. 14, 1883	
Driscoll, A	Edmonton, Alta	Feb. 23, 1887	
Drummond, T	Montreal, Que	June 24, 1878	Dominion Topographical Surveyor.
Ducker, W. A	Winnipeg Man	Mar. 30, 1883	Swamp Land Commissioner.
Dumais, P. T. C	Hull, Que	" 29, 1882	
Edwards, Geo	Ponoka, Alta	April, 14, 1872	
Ellacott, C. H	Victoria, B.C	Feb. 22, 1899	
Empey, J. M	Calgary, Alta	" 23, 1905	
Fairchild, C. C	Brantford, Ont	" 20, 1901	
Farncomb, A. E	Lacombe, Alta	Mar. 12, 1902	
Fawcett, T	Niagara Falls, Ont	Nov. 18, 1876	Dominion Topographical Surveyor.
Fawcett, A	Gravenhurst, Ont	Feb. 22, 1893	
Findlay, A	Winnipeg, Man	Mar. 21, 1908	
Fontaine, L. E	Levis, Que	Nov. 30, 1892	Inspector of surveys, Topographical Surveys Branch, Dept. of Interior.
Foster, F. L	Toronto, Ont	April, 14, 1872	
Francis, J	Poplar Point, Man	June 17, 1875	
Garden, J. F	Vancouver, B.C	May 13, 1880	
Garden, G. H	Lethbridge, Alta	April, 14, 1872	
Garden, C	Not known	" 14, 1872	
Garner, A. C	South Qu'Appelle, Sask	May 27, 1907	
Gauvreau, L. P	Not known	April 14, 1872	
Gibbons, J	Dawson, Yukon Territory	Feb. 12, 1891	
Gordon, M. L	Vancouver, B.C	" 18, 1904	
Gordon, R. J	Raymond, Alta	Mar. 12, 1902	
Gore, T. S	Victoria, B.C	April 19, 1879	
Green, A. H	Nelson, B.C	Feb. 23, 1905	
Green, T. D	Prescott, Ont	May 19, 1884	
Green, W. T	Ottawa, Ont	Feb. 22, 1907	Topographical Surveys Branch Dept of Interior.
Grover, G. A	Norwood, Ont	" 18, 1904	
Harris, J. W	Winnipeg, Man	April 14, 1872	City Surveyor, Winnipeg.
Harvey, C	Indian Head, Sask	Feb. 17, 1904	
Hawkins, A. H	Listowel, Ont	Mar. 6, 1906	
Heathcott, R. V	Edmonton, Alta	May 13, 1907	
Henderson, W	Not known	Nov. 17, 1883	
Holcroft, H. S	Toronto, Ont	Feb. 18, 1903	
Hopkins, M. W	Edmonton, Alta	" 20, 1901	
Hubbell, E. W	Ottawa, Ontario	May 19, 1884	Topographical Surveys Branch, Dept. of Interior, President of D.L.S. Association.
James, S	Toronto, Ont	April 14, 1872	
Jephson, R. J	Brandon, Man	May 12, 1880	
Johnson, A. W	Kamloops, B.C	Mar. 12, 1902	
King, W. F	Ottawa, Ont	Nov. 21, 1876	Dominion Topographical Surveyor, Chief Astronomer, Dept. of Interior.
Kimpe, M	Edmonton, Alta	May 13, 1907	
Kirk, J. A	Revelstoke, B.C	" 11, 1880	
Kitto, F. H	Ottawa, Ont	Mar. 6, 1808	Topographical Surveys Branch, Dept. of Interior.
Klotz, O. J	"	Nov. 19, 1877	Dominion Topographical Surveyor, Astronomer, Dept. of the Interior.

APPENDIX No. 11—*Continued.*

LIST OF DOMINION LAND SURVEYORS WHO HAVE BEEN SUPPLIED WITH STANDARD MEASURES—*Continued.*

Name.	Address.	Date of Appointment.	Remarks.
Knight, R. H.	Edmonton, Alta	Feb. 18, 1904	
Latimer, F. H.	Detroit, Mich.	Nov. 13, 1885	
Laurie, R. C.	Battleford, Sask.	April 27, 1883	
Lawe, H.	Ottawa, Ont.	" 14, 1872	Topographical Surveys Branch, Dept. of Interior.
Lemoine, C. E.	Quebec, Que.	Mar. 31, 1882	
Lendrum, R. W.	Strathcona, Alta.	May 15, 1880	
Lonergan, G. J.	Buckingham, Que.	Feb. 28, 1901	Inspector of Surveys, Topographical Surveys Branch, Dept. of Interior.
Lumsden, H. D.	Ottawa, Ont.	April 14, 1872	Chief Engineer Trans. Ry.
MacPherson, C. W.	Dawson, Yukon Territory	Mar. 7, 1900	Director of Surveys, Y.T.
Magrath, C. A.	Lethbridge, Alta.	Nov. 16, 1881	Dominion Topographical Surveyor, Member of Parliament.
Meadows, W. W.	Maple Creek, Sask.	Feb. 23, 1905	District Surveyor and Town Engineer.
Miles, C. F.	Toronto, Ont.	April 14, 1872	Inspector of Surveys, Topographical Surveys Branch, Dept. of Interior.
Moberly, H. K.	Innisfail, Alta.	" 21, 1903	
Molloy, J.	Winnipeg, Man.	" 14, 1872	
Montgomery, R. H.	Prince Albert, Sask.	Feb. 23, 1905	
Moore, H. H.	Calgary, Alta.	Feb. 17, 1904	
Morrier, J. E.	Ottawa, Ont.	May 16, 1907	
McArthur, J. J.	Ottawa, Ont.	April 17, 1879	Boundary Surveys, Dept. of Interior.
McColl, G. B.	Winnipeg, Man.	Mar. 20, 1907	Dominion Topographical Surveyor.
McDiarmid, S. S.	Vancouver, B.C.	Feb. 23, 1905	
McFadden, M.	Neepawa, Man.	April 14, 1872	
McFarlane, J. B.	Toronto, Ont.	June 3, 1908	
McFarlane, W. G.	Toronto, Ont.	May 19, 1905	
McFee, A.	Red Deer, Alta.	April 19, 1879	
McGrandle, H.	Wetaskiwin, Alta.	May 30, 1883	
McKenna, J. J.	Dublin, Ont.	April 14, 1872	
McKenzie, J.	New Westminster, B.C.	Nov. 18, 1887	Dominion Lands Agent, New Westminster.
McLean, J. K.	Ottawa, Ont.	April 1, 1882	Dept. of Indian Affairs.
MacLennan, A. L.	Toronto, Ont.	Feb. 23, 1905	
McMillan, G.	Ottawa, Ont.	" 22, 1906	
McPherson, A. J.	Dawson, Yukon Territory	" 21, 1901	
McPhillips, G.	Winnipeg, Man.	June 17, 1875	
McVittie, A. W.	Blairmore, Alta.	Mar. 30, 1882	
Nash, T. S.	Ottawa, Ont.	Feb. 18, 1904	Topographical Surveys Branch, Dept. of Interior, secretary-treasurer of the D.L.S. Assn.
Ogilvie, W.	Paris, Texas	April 14, 1872	
O'Hara, W. F.	Ottawa, Ont.	Feb. 19, 1895	
Ord, L. R.	Hamilton, Ont.	April 1, 1882	
Parsons, J. L. R.	Regina, Sask.	Feb. 23, 1905	
Patrick, A. P.	Calgary, Alta.	Nov. 19, 1877	Dominion Topographical Surveyor.
Pearce, W.	Calgary, Alta.	May 10, 1880	
Phillips, E. H.	Saskatoon, Sask.	Feb. 24, 1902	Dept. of Public Works for Saskatchewan.
Plunkett, T. H.	Meaford, Ont.	Mar. 12, 1908	
Ponton, A. W.	Macleod, Alta.	May 18, 1881	
Proudfoot, H. B.	Saskatoon, Sask.	Mar. 28, 1882	
Rainboth, E. J.	Ottawa, Ont.	May 19, 1881	
Rainboth, G. C.	Aylmer, Que.	April 14, 1872	Boundary Surveys, Dept. of Interior.
Reid, J. L.	Ottawa, Ont.	" 14, 1872	Dept. of Indian Affairs.
Reilly, W. R.	Regina, Sask.	Nov. 17, 1881	
Richard, J. F.	Ste. Anne de la Pocatière, Que.	May 13, 1882	
Rinfret, R.	Quebec, P.Q.	Feb. 20, 1900	
Ritchie, J. F.	Nelson, B.C.	Jan. 7, 1889	

APPENDIX No. 11—*Continued.*

List of Dominion Land Surveyors who have been supplied with Standard Measures—*Continued.*

Name.	Address.	Date of Appointment.	Remarks.
Robertson, H. H.	Not known.	April 14, 1872	
Roberts, S. A	Victoria, B.C.	May 16, 1885	
Roberts, V. M.	Sturgeon Falls, Ont	" 17, 1886	
Robinson, E. W.	Victoria, B.C.	" 1, 1908	
Robinson, F. J.	Regina, Sask	Feb. 20, 1906	Dept. of Public Works for Saskatchewan.
Rolfson, O.	Walkerville, Ont.	July 11, 1908	
Rombough, M. B.	Morden, Man.	April 14, 1872	
Rorke, L. V.	Toronto, Ont	Aug. 13, 1891	
Ross, G	Welland, Ont.	Nov. 21, 1882	
Ross, J. E.	Kamloops, B.C.	Feb. 12, 1891	
Roy, G. P.	Quebec, Que.	Nov. 17, 1881	
Saint Cyr, J. B.	Montreal, Que.	Feb. 17, 1887	
Saint Cyr, A.	Ottawa, Ont.	" 17, 1887	
Saunders, B. J.	Edmonton, Alta.	Nov. 16, 1884	
Scott, W. A	Galt, Ont.	Mar. 19, 1909	
Seagar, E.	Kenora, Ont.	April 14, 1872	
Selby, H. W.	Toronto, Ont.	Nov. 15, 1882	
Seymour, H. L.	Edmonton, Alta	Feb. 22, 1906	
Sewell, H. de Q.	Toronto, Ont,	May 16, 1885	
Shaw, C. A. E	Victoria, B.C	" 10, 1880	
Shepley, J. D.	Maple Creek, Sask.	Mar. 12, 1906	
Smith, C. C	Ottawa, Ont.	Feb. 22, 1906	Dominion Observatory, Dept. of Interior.
Speight, Thos.	Toronto, Ont.	Nov. 16, 1882	
Starkey, S. M	Starkey's P.O., N.S	April 14, 1872	
Steele, I. J.	Ottawa, Ont.	" 16, 1908	
Stewart, G. A.	Calgary, Alta	" 14, 1872	
Stewart, L. B.	Toronto, Ont	Nov. 22, 1882	Dominion Topographical Surveyor, Professor of Surveying, School of Practical Science.
Stewart, E.	Montreal, Que,	April 14, 1872	
Stewart, W. M.	Hamilton, Ont.	June 6, 1907	
Talbot, A. C.	Calgary, Alta	May 13, 1880	
Taylor, A	Not known	June 9, 1904	
Teasdale, C. M.	Concord, Ont	Mar. 9, 1906	
Thompson, W. T.	Fort Qu'Appelle, Sask.	Nov. 19, 1877	Dominion Topographical Surveyor.
Tracy, T. H.	Vancouver, B.C.	April 14, 1872	City Engineer, Vancouver.
Tremblay, A. J.	Les Eboulements, Que.	Feb. 18, 1890	
Turnbull, T.	Winnipeg, Man.	Mar. 29, 1882	
Tyrrell, J. W.	Hamilton, Ont	Feb. 16, 1887	
Vaughan, J. W.	Vancouver, B.C.	June 11, 1878	
Vicars, J.	Kamloops, B.C.	May 17, 1886	
Waddell, W. H.	Hamilton, Ont.	Mar. 25, 1907	
Waldron, J	Moosejaw, Sask.	April 2, 1907	
Walker, E. W.	Regina, Sask	Mar. 27, 1907	Dept. of Public Works for Saskatchewan.
Wallace, J. N	Calgary, Alta.	Feb. 20, 1900	
Warren, J.	Walkerton, Ont.	April 14, 1872	
Watt, G. H.	Prince Albert, Sask.	Feb. 24, 1902	
Weekes, A. S.	Edmonton, Alta.	" 11, 1892	
Weekes, M. B.	Regina, Sask	" 18, 1903	Dept. of Public Works for Saskatchewan.
Wheeler, A. O.	Calgary, Alta.	Nov. 21, 1882	Topographer of the Department of the Interior.
White-Fraser, G. W. R.	Ottawa, Ont.	Feb. 21. 1888	Dominion Topographical Surveyor.
Wiggins, T. H.	Saskatoon, Sask.	" 18, 1896	
Wilkins, F. W.	Norwood, Ont.	May 18, 1881	Dominion Topographical Surveyor.
Wilkinson, W. D.	Not known.	Feb. 22, 1893	
Williams, G. L.	Vancouver, B.C.	June 24, 1908	
Woods, J. E	Frank, Alta.	Nov. 14, 1885	
Young, W. B.	Winnipeg, Man	Mar. 25, 1905	
Young, W. H.	Lethbridge, Alta.	May 17, 1907	

APPENDIX No. 12.

EXAMINATION PAPERS OF THE BOARD OF EXAMINERS FOR DOMINION LAND SURVEYORS.

FEBRUARY, 1909.

EXAMINATION FOR ADMISSION AS ARTICLED PUPIL—FULL PRELIMINARY.

XXXIII.

February 9 to 12, 1909

PENMANSHIP AND ORTHOGRAPHY.

(Time, 3 hours.)

Marks

Write out the following, correcting the errors in spelling:—

Their ar kaisses in witch we rekkun withe thee moast unfaileing konfiddents up on yewneformitie, and uther kaisses in witch wee do knot kownt on itt at awl. In sum, we feal kompleat asurants that the fewtur will rezembel the passed, the unnoan bee presislie simmiler to the noan. In uthers, howevver invairyabel meigh bee the rezult obtaned from the instanses witch we have observt, we draw from them know moar than a verry feabel pressumshun that th lyk reezult will hould in awl uther kaisses. That a strait lyne iz the schortesd disstants betwean two poynce. We do knot dowte to bee trew eavin in the reejun off the ficksed starrs. Wen a kemmist anownses the eggsistents and propperties of a knewlie diskuvered substants, if we konfyde in his akurasie we feal asured that the konklewshuns he haz arivt at will howld universelly, altho the indukshun be fownded but on a singel instants. We do knot withoald our ascent wayting four e reppitishun of the eggsperrymeant; or if we doo, it iz fromm a dowte weather the wun egsperrymeant waz propparly maid not wether if propperly maid it wood bee konklewsif. Hear then iss a jennerel law of naityure, inferd withou' hezetaishon from a singgel instants ; ann yewniversel proppossishun from a singgeler wun. Now marqu anuther kaisse, and kontrasst it with thiss. Knot awl the instences witch have bin obzervt sints the beggining of the wurld, in support of the jenarel proppossisshun that awl kroaz are blak wood bee deamt a sufishent presummshun of the trewth of the proppossisshun, to outway the tesstemoney of wun unexeptionable wittnes who shud afirm that in sum reejun of the erth knot fuly egsploured hee had kawt and egzammint a kro, and had fownt it to be gra. { 50 / 200

SESSIONAL PAPER No. 25b

ARITHMETIC AND LOGARITHMS.

(Time, 3 hours.)

Marks

1. Find the least number which when divided by 4 has remainder 3; when by 10, remainder 9 ; when by 14, remainder 13 ; when by 15, remainder 14 ; and when by 21, remainder 20. 13

2. A vessel has three outlets, A, B and C. By A alone it may be emptied in 5 hours, by B in 7 hours, while C will empty it in two-thirds of the time which A and B acting together require. In what time can the vessel be emptied by the three taps together? 13

3. Find (without using logarithms) the square root of $\frac{1.28}{12.5}$, and the cube root of $405\frac{28}{125}$. 14

4. Find the angles for 15

$$\log \sin = 9.6234562$$
$$\log \tan = 0.2345678\ n$$
$$\log \sec = 0.3148923\ n.$$

5. Find the value of 15

$$\left(\tfrac{1}{3}\right)^{\frac{1}{3}} - \left(\tfrac{2}{3}\right)^{-\frac{1}{2}} + \left(\tfrac{1}{5}\right)^{\frac{3}{5}} - \left(\tfrac{5}{7}\right)^{-\frac{1}{6}}$$

6. Find log sin 92° 13′ 53″ 15
log cos 104° 15′ 38″
and log tan 65° 17′ 33″.

7. Find the numerical value of 15
sin A + cos B + sec C, when
A = 52° 13′ 15″ ; B = 118° 20′ 36″
C = 82° 17′ 19″.

ALGEBRA.

(Time, 3 hours.)

1. Factor $2b^2c^2+2c^2a^2+2a^2b^2-a^4-b^4-c^4$. 12

2. Find the *H.C.F.* of $x^4-px^3+px^2-p^2\ x$ and x^3-p^3. 12

3. Find the *L.C.M.* of $x^2-(a+b)\ x+ab$, $x^2-(b+c)\ x+bc$, and $x^2-(c+a)\ x+ca$ 12

4. Simplify $\frac{a-b}{a+b} + \frac{b-c}{b+c} + \frac{c-a}{c+a} + \frac{(a-b)\ (b-c)\ (c-a)}{(a+b)\ (b+c)\ (c+a)}$ 12

5 Solve the simultaneous equations,

$$3x+4y+\ z=\ 22$$
$$7x-9y+8z=\ 19$$
$$2x+\ y-4z=\ -9$$ 13

6. Solve

$$\sqrt{\frac{x-4}{x-3}} + \sqrt{\frac{x+3}{x+4}} = \frac{7}{\sqrt{x^2+x-12}}$$ 13

7. Solve $x^3+y^3+z^3=x^2+y^2+z^2=x+y+z=1$. 13

8. Solve 13

$$x^{\frac{1}{n}} + x^{-\frac{1}{n}} = \tfrac{5}{2}$$

PLANE GEOMETRY

First Paper.

(Time, 3 hours.)

Marks.

1. Define a triangle. How many kinds of triangles are there according to the variation both of the angles and of the sides ? 12

2. Construct a triangle of which the sides shall be equal to three given straight lines. 13

3. What limitation is there as regards the lengths of the given straight lines in the last question? Is there a similar limitation with regard to the angles? 12

4. Equal triangles upon equal bases in the same straight line, and towards the same parts, are between the same parallels. 13

5. If a straight line be bisected and produced to any point, the rectangle contained by the whole line thus produced and the part of it produced, together with the square on half the line bisected, is equal to the square on the straight line which is made up of the half and the part produced. 13

6. State the algebraic proposition corresponding to the geometrical one in question 5, and enunciate Euclid's propositions corresponding to the algebraic ones

$$(a + b)^2 + (a - b)^2 = 2\ a^2 + 2\ b^2$$
$$4\ ab + (a - b)^2 = (a + b)^2$$ 12

7. In every triangle the square on the side subtending either of the acute angles is less than the squares on the sides containing that angle by twice the rectangle contained by either of these sides and the perpendicular let fall upon it from the opposite angle 13

8. If two circles cut one another they shall not have the same centre. 12

PLANE GEOMETRY.

Second Paper

(Time, 3 hours.)

Marks.

9. A segment of a circle being given, describe the circle of which it is the segment. 12

10. In a circle the angle in a semicircle is a right angle; but the angle in a segment greater than a semicircle is less than a right angle; and the angle in a segment less than a semicircle is greater than a right angle. 13

11. What are the angles in the segments cut off by an inscribed regular pentagon? What part of the whole circumference is the arc of a segment containing half a right angle? 12

12. Describe an isosceles triangle having each of the angles at the base double of the third angle. 13

13. In a given circle inscribe an equilateral and equiangular quindecagon. 12

14. Give Euclid's criterion of proportionality. 12

15. Similar triangles are to one another in the duplicate ratio of their homologous sides. 13

16. In equal circles, angles, whether at the centres or circumferences, have the same ratio which the circumferences on which they stand have to one another; so also have their sectors. 13

PLANE TRIGONOMETRY.

(Time, 3 hours.)

Marks.

1. In any triangle, prove the formulæ 14

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$a \cos B + b \cos A = c.$$

2. Prove that $\sin 3A = 3 \sin A - 4 \sin^3 A$. 14

3. Given $a = 35 \cdot 3$, $b = 54 \cdot 7$, $A = 33° 25'$, solve the triangle 18

4. Given $b = 17 \cdot 34$, $c = 29 \cdot 85$, $A = 125° 43'$; find a. 18

5. Given $A = 25° 33'$, $B = 117° 08'$, $a = 125 \cdot 33$; find c. 18

6. Given $a = 23 \cdot 5$, $b = 37 \cdot 7$, $c = 31 \cdot 2$; find the angles. 18

SPHERICAL TRIGONOMETRY.

(Time, 3 hours.)

Marks.

1. What is meant by the polar triangle? What is the relation between the sides and angles of a spherical triangle and those of the corresponding polar triangle? 20

2. Given $c = 145°$; $a = 25°$; $C = 90°$, solve the triangle. 20

3. Given $b = 123° 15'$; $c = 135° 10'$; $A = 15° 27'$, find a. 20

4. Given $B = 140° 10'$; $C = 55° 42'$; $a = 63° 26'$, find A. 20

5. Given $A = 125°$; $B = 135°$; $c = 85°$, find a. 20

MENSURATION.

(Time, 3 hours.)

Marks.

1. The sides of a triangular field are 10·36, 12·42 and 14·82 chs. What is its area? 17

2. What part of the surface of the earth lies between the parallels of 30° and 60° north latitude? 17

3. A right cone with base 36 feet in circumference and 10 feet high is cut by a plane parallel to the base so that the surface of the lower part is five times that of the upper. What is the height of the truncated cone? 17

4. A test of the chain used in making the measurements noted in question 1 having shown the chain to be half a link too short, what is the corrected area of the field? 16

5. The edge of a regular tetrahedron is 36 inches. What is the diameter of the sphere having the same surface as the tetrahedron? 17

6. A circular half mile race track is 30 feet wide; the half mile line is 3 feet from the inner limit of the track. How many acres are covered by the track? 16

EXAMINATION FOR ADMISSION AS ARTICLED PUPIL—LIMITED PRELIMINARY.

XXI.

February 9, 1909.

FIRST PAPER.

(Time, 3 hours.)

Marks.

1. Penmanship and Orthography. (Same as in Full Preliminary Examination.) 50 } 200

2. The eagle weighs 258 grains, nine-tenths pure gold; 1869 sovereigns weigh 480 ounces Troy, eleven-twelfths pure gold. Find the value of the sovereign in terms of the dollar. 50

3. If $x^3 + px^2 + qx + r$ vanish for $x = a$, or $= b$, or $= c$, determine p, q, and r in terms of a, b, c. 50

4. If $\frac{a+b}{3\ (a-b)} = \frac{b+c}{4\ (b-c)} = \frac{c+a}{5\ (c-a)}$ prove that $32\ a + 35\ b + 27\ c = 0$. 50

5. A ladder is gradually raised against a wall; find the locus of its middle point. 50

6. In a triangle, prove that the area $= \sqrt{s\ (s-a)\ (s-b)\ (s-c)}$ where $s = \frac{1}{2}\ (a+b+c)$ 50

7. If $\tan^2 A = 1 + 2 \tan^2 B$, then will $\cos 2B = 1 + 2 \cos 2A$. 50

8. Prove that, in equal circles, angles at the centre are proportional to the arcs on which they stand. 50

SECOND PAPER.

(Time, 3 hours.)

Marks.

9. If O be the centre of the circumscribed circle of the triangle ABC, and AO meet BC in D, $DO : AO = \cos A : \cos (B - C)$. 50

10. If the surface areas of a sphere, a cube and a regular tetrahedron be each 36 square feet, find the lengths of the diameter of the sphere, and the edges of the cube and tetrahedron. 50

11. Prove that in equal circles the angles at the centre are proportional to the arcs on which they stand. 50

12. Find the locus of a point whose distances from two given points are in a given ratio. 50

13. Given $b = 99° 41'$; $c = 100° 50'$; $A = 65° 33'$, find a. 50

14. Given $c = 75° 31'$; $a = 90°$; $B = 30° 53'$, find the other parts. 50

15. Find the value of $(2\frac{3}{31})^{\frac{3}{4}} + (1\frac{3}{17})^{-\frac{4}{5}} + (\frac{3}{4})^{\frac{2}{3}} - (2\frac{8}{39})^{-1\frac{1}{2}}$ 50

FINAL EXAMINATION FOR DOMINION LAND SURVEYOR.

XLI.

February 9 to 16, 1909.

PENMANSHIP AND ORTHOGRAPHY.

Marks.

(Time, 3 hours.)

The same paper as in the Full Preliminary Examination. { 50 / 200

ALGEBRA.

Marks.

(Time, 3 hours.)

1. Find the *H. C. F.* and *L. C. M.* of
$20x^4 + x^2 - 1$, $25x^4 + 5x^3 - x - 1$, $25x^4 - 10x^2 + 1$. 10

2. Resolve $9x^6y^2 - 576y^2 - 4x^8 + 256x^2$ into six factors. 10

3. Multiply
$$\sqrt{2x} + \sqrt{2(2x-1)} - \frac{1}{\sqrt{2x}} \text{ by } \frac{1}{\sqrt{2x}} + \sqrt{2(2x-1)} - \sqrt{2x}$$ 10

4. If p be the difference between any quantity and its reciprocal, q the difference between the square of the same quantity and the square of its reciprocal, show that $p^2(p^2 + 4) = q^2$. 10

5. Extract the square root of $7 - 30\sqrt{-2}$. 10

6. Given that 4 is the root of the quadratic $x^2 - 5x + q = o$, find the value of q and the other root.

7. What is the amount of a dollars, in b years at c per cent compound interest? 10

8. (1) Given log 2 = ·301030, log 3 = ·477121 and log 7 = ·845098, find the logarithm of ·005, 6·3, and $\left(\frac{49}{216}\right)^{\frac{1}{3}}$ 10

(2) Find x from the equation $\frac{8-4x}{18}=\left(54\sqrt{2}\right)^{3x-2}$

9. If a, b are the roots of $x^2 + px + q = o$, show that p, q, are the roots of the equation $x^2 + (a + b - ab)\, x - ab\ (a + b) = o$. 10

10. A lawn 50 ft. long and 34 ft. broad has a path of uniform width around it; if the area of the path is 540 square ft., find its width. 10

PLANE GEOMETRY.

(Time, 3 hours.)

	Marks.
1. In a right-angled triangle, prove $c^2 = a^2 + b^2$	18
2. In any triangle prove $c^2 = a^2 + b^2 - 2ab \cos C$.	18
3. Find a point at which each of two given finite straight lines subtends a given angle.	19
4. The locus of a point from which tangents drawn to two given circles are equal, is a straight line	19
5. If two chords of a circle when produced intersect at a point without a circle, the rectangle contained by the segments of one chord is equal to the rectangle contained by the segments of the other chord.	19
6. If a straight line be drawn through a given point to cut a given circle, the intersection of the tangents at the two points of section always lies on a fixed straight line.	19
7. If an angle of a triangle be bisected internally and externally by a straight line which cuts the opposite side or that side produced, the ratio of the segments of that side is equal to the ratio of the other sides of the triangle.	19
8. If three straight lines be drawn from the vertices of a triangle meeting in a point and cutting the opposite sides or the sides produced, the ratio compounded of the ratio segments of the sides taken in order is equal to unity.	19

SOLID GEOMETRY.

(Time, 3 hours.)

	Marks
1. Name the regular solids, and give the number of faces, corners and edges for each.	8
2. If two straight lines are cut by three parallel planes, they will be divided proportionally.	8

3. The sum of any two of the plane angles formed by the edges of a trihedral angle, is greater than the third. 8

4. The sum of the plane angles of a trihedral angle is less than four right angles. 8

5. A cube, a tetrahedron and a sphere have each the same surface, S. Find side, edge and diameter respectively; also the volume of each. 8

6. If the mean density of the earth is 5·56, what will be the mean density when the diameter contracts ten per cent? 8

7. Into a cylindrical vessel 10 inches wide and 20 inches deep, filled with water are placed an iron ball 8 inches in diameter, and a wooden cylinder, specific gravity ·7, seven inches in diameter and seven inches long. How many gallons of water will be displaced, taking 10 lbs. to the gallon, and 62·5 lbs. to the cubic foot of water? 9

8. What is the angle subtended by the developed arc of the tangent cone, tangent to the earth at latitude 45°? 9

9. A sphere is placed in water; it is found that one-third of its surface is above the water. What is the specific gravity of the sphere? 9

SPHERICAL TRIGONOMETRY.

(Time, 3 hours).

Marks.

1. Deduce the fundamental equations.
   (1) $\cos a = \cos c \cos b + \sin c \sin b \cos A$.
   (2) $\sin a \cos B = \sin c \cos b - \cos c \sin b \cos A$.
   (3) $\sin a \sin B = \sin b \sin A$. 25

2. Prove Napier's analogies. 20

3. Given $a = 120°$, $b = 70°$, $A = 130°$, find C and B. 20

4. Given $A = 80° 10' 30''$, $b = 155° 46' 42''·7$, $C = 90°$ Solve the triangle. 20

5. Show that $\sin \frac{1}{2} A = \sqrt{\frac{\sin (s-b) \sin (s-c)}{\sin b \sin c}}$. 20

6. Given $A = 120°$, $B = 130°$, $C = 80°$, find c. 20

MEASUREMENT OF AREAS AND SUBDIVISION OF LAND.

First Paper.

(Time, 3 hours).

Marks.

1. What is the latitude of the parallel that bisects the area of the north temperate zone, taking the limits of the zone at 23° 30′ and 66° 30′? 16

2. Taking the mean parallax of the sun as 8″.8, what fractional part of the sun's radiation is intercepted by the earth? 16

3. In a quadrilateral $ABCD$ the sides are respectively AB=8 chs., BC=9 chs., CD=6 chs., and DA=8 chs, the diagonal DB=14 chs. Required to divide it into three equal parts by two straight lines drawn from A. 17

4. To divide a triangular field into two parts in a given ratio $m : n$ by the shortest line. 17

5. The centre line of a railway runs off on a curve of 2,000 ft. radius from a tangent, N. 30° E. at its intersection with the west limit of S. 34, T 23, R. IV W. of 3rd M., 12 chs. south of the N. W. corner of the section. The centre of the curve is in S 34. The right of way extends 50 ft. on each side of the centre line. What is the area of that part of the N. W. ¼ section lying north of the railway? 17

6. What is the area enclosed by the half mile line of a race track; the half mile line being composed of two tangents making an angle of 60° with each other, and of an arc of a circle? 17

MEASUREMENT OF AREAS AND SUBDIVISION OF LAND

Second Paper.

(Time, 3 hours.)

Marks.

7. The following are the notes of a survey of a quadrilateral piece of land:

1. N. 52° 00′ E.	10·63 chs.
2. S. 29° 45′ E.	4·10 "
3. S. 31° 45′ W.	7·69 "
4. N. 61° 00′ W.	7·13 "

Find the area by the method of Latitudes and Departures, first balancing the survey. 40

8. Express the conditions necessary for a closed survey by two equations:
(*a*) And from them show what missing data in a survey can be supplied.
(*b*) How does the supplying of missing data in a survey affect "balancing" the survey? 20

9. Give full explanation and deduction of the method of computing areas by "latitudes and departures," using a figure of not less than four sides. 20

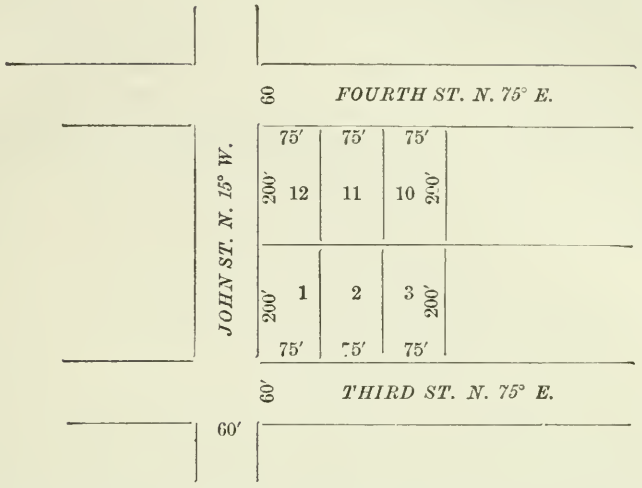
10. If, in question 7, the supposed position of the north point was in error 15 minutes, and the chain was a link too short; what is the true area of the quadrilateral? 20

DESCRIPTIONS.

(Time, 3 hours.)

Marks.

1.



The above is part of the registered plan of the town of Holly in the County of Tweed and Province of Alberta. *A* sells to *B* a part of lot No. 1 and adjoining John and Third streets. The part sold is to have a frontage of forty feet on Third street to extend to the rear of the lot and the dividing line to be parallel to John street. Make a description for a deed. 25

2. Using the plan of question 1. Supposing *A* to own lots Nos. 1 and 2, he sells lot No. 2 to *B*, and gives the right of ingress and egress to *B* by a lane, 16 feet wide, running along the whole of the rear limit of lot No. 1. Make the necessary description for the conveyance. 25

3. Moose Creek flows across the N.E. ¼ S. 12, T. 13, R. 15 W. in an easterly direction. *B* desires to buy the northerly part of the quarter section lying north of the creek, together with the creek. From measurement the southerly bank of the creek intersects the eastern and western quarter section lines respectively at 22^{ch}. 12 and 20^{ch}. 18 from the northern quarter section line. The whole area to be conveyed is supposed to contain 85 acres. Make a description for a deed. 25

4. Make a description for the remaining part of the quarter section given in question 3. 25

ASTRONOMY.

First Paper.

(Time, 3 hours.)

Marks.

1. Define—declination, right ascension, celestial latitude and longitude, first point of Aries; parallactic angle; dip, parallax, and elongation. 13
2. Explain fully the equation of time, why it varies, and when it is a maximum. A diagram is desirable. 13

3. In latitude 45° 25′ N., longitude 75° 42′ W., what is the standard time on March 31, 1904, of eastern elongation of Polaris? 13

4. At same place and date as above what is the standard time of sunset? Semi-diameter, refraction and parallax to be considered. 13

5. At same date and place as above what is the apparent altitude of Polaris at lower transit? 12

6. At same place what is the limit in declination of stars that can be observed on the prime vertical. 12

7. At same place the apparent altitude of a star on the prime vertical was 37° 08′ 30″, what was its declination? 12

8. In the last question what was the altitude of that star when its hour angle was 3h. 30m.? 12

ASTRONOMY.

SECOND PAPER.

(Time, 3 hours.)

Marks.

9. On July 12, 1904, on the 4th Base Line R. X., XI, W. of 3rd M., the observed altitude of the sun's lower limb at $8^h\ 20^m\ 15^s$ watch time was 42° 28′ 15″. What was the watch correction, and what was the azimuth of the sun? 20

10. In question 9, what was the true local sidereal time of observation? 20

11. At mean noon on July 12, 1904, in Longitude 90° W. a sidereal chronometer is slow $13^s.56$ on local sidereal time and has a daily rate, gaining, of $1^s.96$; while at another place to the West at the same time, a mean time chronometer is fast $18^s.96$ on local mean time and has a losing rate daily of $1^s.62$. Ten days later at mean noon of the former place the two chronometers are compared by telegraph and found to differ by $8^h\ 38^m\ 57^s.62$. What is the difference of longitude between the two places? 20

12. At the same place and date as in question 9, at what standard time will Sirius rise? 20

13. On June 30, 1904, the altitude of the upper limb of the sun at its lower or northern culmination was 11° 15′ 20″. What was the latitude of the place? 20

MANUAL OF SURVEY AND DOMINION LANDS SURVEYS ACT.

FIRST PAPER.

(Time, 3 hours.)

Marks.

1. Where is the Coast Meridian? 4

2. What are the differences between the third and the fifth systems of survey? 4

3. Define a bearing and an azimuth. 15

4. To what meridian is a bearing referred in subdividing a township and how is it deduced from an observed azimuth? 11

5. How is the deficiency or surplus along meridians disposed of between the first and the second base lines? 5

6. What is to be done when the survey line is obstructed by a pond, lake, deep marsh or other obstacle? 5

7. In surveying a meridian in the interior of a township, the surveyor strikes the outline one chain and twenty links from the corner; what must he do? 6

8. The lines around a block of two sections do not close within fifty links; what must the surveyor do? 6

9. In what cases is it necessary for a subdivider to run twice the northern limit of a section in the interior of a township? 6

10. Describe the monuments at a quarter section corner in prairie and at a section corner on a correction line in the woods; also a witness post and trench. 15

11. How is a settlement surveyed? 13

12. By what considerations is a surveyor to be guided in deciding whether a road allowance shall or shall not be left along the boundary of an Indian Reserve? 5

13. What are the objects of the traverses made in subdividing Dominion lands? 5

MANUAL OF SURVEY AND DOMINION LANDS SURVEYS ACT.

Second Paper.

(Time, 3 hours.)

Marks.

14. Describe the method to be followed in making traverses. 6

15. Define the bank and the bed of a body of water. 8

16. When a parcel of land is bounded by a body of water and the water recedes, does the new land belong to the owner of the parcel? 8

17. How are shallow lakes or marshes dealt with? 8

18. Give the marks on the following posts:
    (*a*) At the corner between sections 8, 9, 16 and 17, township 99, range 14, East of the Principal Meridian.
    (*b*) At the southerly corner between sections 26 and 27, township 87, range 17, West of the Fourth Meridian.
    (*c*) At the north easterly corner of section 31, township 114, range 24, West of the Fifth Meridian.
    (*d*) At the northerly corner of township 94, range 14, West of the Third Meridian.
    (*e*) At the witness mound placed 8 chains north of the S.E. corner of section 15, township 43, range 9, West of the Second Meridian. 20

19. Define a resurvey, a retracement, a restoration survey, an obliterated corner, and a lost corner. 8

20. Explain how a surveyor must proceed in order to compel the attendance of persons who have information as to boundaries. 6

21. What is the difference between a legal subdivision and an authorized subdivision? 6

22. What is necessary in order that land may be held to be surveyed? 6

23. Give the provisions of the law respecting the correction of errors in original surveys. 14

24. All the monuments on the south, east and north boundaries of sections 3, 4, 9 and 10, in township 71, range 7, West of the Third Meridian are lost: how must they be reestablished? 10

EXAMINATION FOR CERTIFICATE AS DOMINION TOPOGRAPHICAL SURVEYOR.

XIII.

February 9 to 16, 1909.

ALGEBRA.

(Time, 3 hours.)

Marks.

1. Prove that the square of $r\,r\,r\,r$ in the scale of s is $r\,r\,r\,r\,q\,0\,0\,0\,1$, where q, r, s, are any three consecutive integers. 5

2. If the $n+1$ numbers $a, b, c, d \ldots\ldots\ldots$ be all different, and each of them a prime number, prove that the number of different factors of the expression $a^m\ b\ c\ d \ldots\ldots$ is $(m+1)\ 2^n - 1$. 5

3. The sum of the first $r+1$ co-efficients of the expansion of $(1-x)^{-m}$ is equal to $\overbrace{\underline{|m}\ \underline{|r}}^{|m+r}$ 5

4. Prove that e is incommensurable. 5

5. If a, b, c, denote the sides of a triangle, shew that 5
$$a^2\ (p-q)\ (p-r) + b^2\ (q-r)\ (q-p) + c^2\ (r-p)\ (r-q)$$
cannot be negative; p, q, r being any real quantities.

6. When $a < 1$, find the co-efficient of x^n in the expansion of
$$\frac{1}{(1-ax)\ (1-a^2x)\ (1-a^3x) \ldots\ldots \text{ to infinity.}}$$ 5

7. Find the generating function and the general term of the series 5
$$3 + 6x + 14x^2 + 36x^3 + 98x^4 + 276x^5 + \ldots\ldots$$

8. Prove that $1 + {}^{11}/_{14} + {}^{11}/_{14} \cdot {}^{13}/_{16} + {}^{11}/_{14} \cdot {}^{13}/_{16} \cdot {}^{15}/_{18} + \ldots\ldots$ to $\infty = 12$ 5

9. Shew that $a^{12} - b^{12}$ is divisible by 91, if a and b are both prime to 91. 5

10. Calculate the value of the determinants: 5
$$\begin{vmatrix} a & 1 & 1 & 1 \\ 1 & a & 1 & 1 \\ 1 & 1 & a & 1 \\ 1 & 1 & 1 & a \end{vmatrix}$$

SESSIONAL PAPER No. 25b

PLANE AND SPHERICAL TRIGONOMETRY.

(Time 3 hours.)

Marks.

1. Sum to infinity $2\cos\theta + \frac{3}{2}\cos^2\theta + \frac{1}{3}\cos^3\theta + \frac{5}{4}\cos^4\theta + \ldots\ldots$ 8

2. To find K and Z from the equations 8

$$K \sin(\alpha+Z)=m$$
$$K \sin(\beta+Z)=n$$

3. Develop the sine and cosine of the multiple angle in a series of ascending powers of the tangent of the simple angle. 8

4. Required the increase of log sin θ arising from θ receiving a small increment, $\delta\theta$. 8

5. In a spherical triangle, given a, b and A, determine by inspection whether there are two solutions or but one. 8

6. Give the three fundamental equations for the general spherical triangle. 8

7. In a spherical triangle if C and c remain constant while a and b receive the small increment δa and δb respectively, show that 9

$$\frac{\delta a}{\sqrt{(1-n^2\sin^2 a)}}+\frac{\delta b}{\sqrt{(1-n^2\sin^2 b)}}=0 \text{ where } n=\frac{\sin C}{\sin c}$$

8. Find the locus of the vertex of a spherical triangle of given base and area. 9

9. Deduce Legendre's Theorem: If the sides of a spherical triangle are very small compared with the radius of the sphere, and a plane triangle be formed whose sides are equal to those of the spherical triangle, then each angle of the plane triangle is equal to the corresponding angle of the spherical triangle minus one-third of the spherical excess. 9

ANALYTICAL GEOMETRY.

(Time, 3 hours.)

Two dimensions.

Marks.

1. Find the area of the triangle, the co-ordinates of whose angular points are 4, 5; 3, 7; 2, 8. Rectangular axes. 10

2. Find the condition that the lines $y=m_1 x+c$, and $y=m_2 x+c_2$ may be at right angles, α being the angle between the axes of co-ordinates. 10

3. If $u=0$, $v=0$, $w=0$, be the equations to three straight lines, prove that $lu+mv+nw=0$. (l, m and n being constants) represents a straight line, and that by giving suitable values to l, m and n, it may in general be made to represent any straight line whatever. 10

4. If $S=0$, $S_1=0$, be the equations of two circles in the form $(x-a^2+(y-b)^2-r^2=0$, what does $S-S_1=0$ represent, and what is the distinctive property of this curve? 10

5. Find the locus of the feet of the perpendiculars drawn from the foci of an ellipse upon any tangent to the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$, and if p, p_1 represent the lengths of these perpendiculars find the value of the product $p\ p_1$ in terms of a and b. 10

Three dimensions.

6. Find the angle between the line $\frac{x}{2} = \frac{y}{\sqrt{3}} = \frac{z}{\sqrt{2}}$, and the line 10

$\frac{x}{\sqrt{3}} = y,\ z = o$. Axes rectangular.

7. Find the equation of the plane which passes through the origin and through the line of intersection of the planes 10

$$Ax + By + Cz = D \text{ and}$$
$$A_1 x + B_1 y + C_1 z = D_1;$$

and determine the condition that it may bisect the angle between them

8. Investigate the conditions necessary in order that the equation

$$ax^2 + by^2 + cz^2 + 2a_1 yz + 2b_1 zx + 2c_1 xy = o$$

may represent two planes. 10

9. Prove that the sections of an ellipsoid by parallel planes are similar ellipses. 10

10. If R be the radius of curvature at a point P of the meridian of a spheroid of revolution, N that of a section of the surface through P perpendicular to the meridian, find the radius of curvature of a section through P making an angle θ with the meridian. 10

DESCRIPTIVE GEOMETRY AND PROJECTIONS.

(Time, 3 hours.)

Marks.

1. Determine the traces of a plane which shall contain a given point and be perpendicular to a given line. 9

2. Draw the projection of a cube $2\frac{1}{2}''$ edge when resting with one edge on the horizontal plane, that edge making an angle of 30° with the ground line, and a face containing it inclined at 40°. 9

3. Assuming the earth to be spherical, find by a graphical construction the distance between two points, one in latitude 10° North and the other one in latitude 24° South, their difference of longitude being 76°. 12

4. Construct the perspective of a rectangular pyramid of which the base is on the ground plane, the sides of the base making angles of 20° and 70° with the picture plane. 12

5. Describe the zenithal projection by balance of errors (Airy's). 20

6. Draw the meridians and parallels, five degrees apart, of a gnomonic projection having its centre in latitude 45° and extending 15° in latitude and longitude from the centre. 13

NOTE.—Draw the figures correctly in pencil with compass and protractor.

SESSIONAL PAPER No. 25b

DIFFERENTIAL AND INTEGRAL CALCULUS

(Time 3 hours.)

Marks.

1. Deduce from first principles the differential co-efficients with respect to x of e^x, $\sin^{-1}x$, $\log(x+\sqrt{1-x^2})$ 10

2. Differentiate 10

$$\log\left\{2x-1+2\sqrt{x^2-x-1}\right\}$$

$$\cos^{-1}\frac{3+5\cos x}{5+3\cos x}$$

$$x^x$$

(the x's being n in number)

3. Expand in ascending powers of x to five terms, $\log\tan\left(\frac{\pi}{4}-x\right)$ 10

4. If u is a function of x and y prove that $\frac{d}{dx}\left(\frac{du}{dy}\right)=\frac{d}{dy}\left(\frac{du}{dx}\right)$ and that when u is a homogeneous function of x and y of the n^{th} degree $x\frac{du}{dx}+y\frac{du}{dy}=nu$. 10

5. Within an angle BAC a point P is given, through which it is required to draw a straight line so that the triangle cut off by it shall be the smallest possible. Prove that this line will be bisected at P. 10

6. Find that point in an ellipse at which the angle contained between the normal and the line drawn to the centre is a maximum. 10

7. Sum the series $P_1+\frac{1}{2}P_2+\frac{1}{3}P_3+\ldots\ldots\frac{1}{n}p^n$, 10

where $\frac{1}{p_r}=\frac{n}{r}+\frac{r}{n}$, when n is indefinitely increased.

8. Integrate $\frac{dx}{x(1+x)^2(1+x+x^2)}$ 10

9. Integrate $e^{ax}\cos kx\,dx$ 10

10. The equation of a curve being $(x^2+y^2)^2=x^2-y^2$, find its area between the limits $x=o$ and $x=1$. 10

PROBABILITY AND LEAST SQUARES.

(Time, 3 hours.)

Marks

1. A bag contains 1000 balls numbered from 1 to 1000. One ball is drawn. *A*, who speaks the truth 9 out of 10 times, asserts that the ball drawn is number 257. What is the probability that *A's* assertion is true? 15

2. A bag contains 1000 balls of which it is known that one only is white, and the rest are black. One ball is drawn. *A*, who speaks the truth nine out of ten times, asserts that the white ball is drawn. What is the probability of the truth of his assertion? 15

3. A straight rod is divided at random at two points. What is the chance that a triangle may be formed having the three parts as sides? 20

4. On the assumption that the arithmetic mean of a number of measurements is the most probable value of the quantity sought, deduce the equation of the curve of probability of an error. 20

5. Two sides a and b of a triangle and the included angle C having been measured, with probable errors α, β and γ respectively; α and β being expressed in terms of the unit of length and γ in seconds of arc; find the probable error of the area found by the formula $\frac{1}{2} ab \sin C$. 20

6. If m observations have been made of linear functions of n unknown quantities, $(m>n)$, derive the method of determining the most probable values of the unknowns. 20

7. Give a practical form of solution of the problem stated in question 6, showing how an arithmetical check may be applied. How may the weights of the resulting values of the unknowns be determined? 20

8. If at four points of a triangulation the horizontal angles between all the lines of the quadrilateral have been measured, show how the most probable corrections to the observed values may be obtained. How many independent conditions are there? 20

GEODESY.

Marks.

(Time, 3 hours.)

1. What conditions must a surveyor fulfil in establishing a chain of triangles? In what cases must preference be given to particular systems? 20

2. Explain how horizontal angles are measured at a triangulation station. 15

3. What is trigonometrical levelling?
Deduce the formulae for reciprocal but not simultaneous observations and expand them into series. 25

4. Deduce the value of the correction for phase.
What data have to be recorded when this correction is required? 15

5. Explain the difference between an astronomical and a geodetic azimuth and give the expression for its value. 25

6. Deduce a formula for the area of a trapezoid formed by two meridians and two parallels, assuming the earth to be a spheroid. 25

ASTRONOMY.

First Paper.

Marks.

(Time, 3 hours.)

1. Given the declination and the right ascension of a star, and the obliquity of the ecliptic, to find the latitude and longitude of the star. 16

2. Given the following ephemeris of the moon, find the difference of the moon's right ascension in one minute for March 5, 0^h. 16

	h.	h.	m.	s
March	3, 12	20	28	17·88
	4, 0	20	58	57·08
	4, 12	21	29	02·01
	5, 0	21	58	28·39
	5, 12	22	27	15·43
	6, 0	22	55	25·50
	6, 12	23	23	03·39

3. Discuss the effect of errors in the data upon the time computed from an altitude. 17

4. Discuss the method for determining latitude from observations on stars at the same altitude when the time is given. 17

5. Deduce formulæ for obtaining latitude by observing the sum of the azimuths of two stars at eastern and western elongation respectively; and discuss the same with reference to choice of stars dependent upon declination. 17

6. On February 12, 1906, in latitude 45° 25′ N., longitude 75° 42′ W., what was the standard time when α and β Orionis were in the same vertical plane? 17

$\delta_\alpha = 7°\ 23'$ N. $\quad \alpha_\alpha = 5^h\ 50^m$

$\delta_\beta = 8°\ 19'$ S. $\quad \alpha_\beta = 5^h\ 10^m$

ASTRONOMY.

Second Paper.

(Time, 3 hours).

Marks.

7. Deduce the equations of the transit instrument in the meridian. 14

8. Give formulae for reduction of thread intervals; for level constant; for inequality of pivots; for collimation constant; for azimuth constant; and for daily aberration. 14

9. In Talcott's method for obtaining latitude deduce formula for 'reduction to the meridian.' 14

10. Give the formulae for deducing the mean place of a star from a given epoch to another; and also the formulae for reducing a star from mean to apparent place, explaining fully the meaning of the symbols used in the formulae. 14

11. In latitude 38° 59′ N., longitude $5^h\ 05^m\ 57{\cdot}5^s$ W., the sun was observed at the same altitude A. M. and P. M. by a chronometer regulated to Greenwich mean time; the mean of the A. M. times was $1^h\ 08^m\ 26{\cdot}6^s$, and the P. M. times $8^h\ 45^m\ 41{\cdot}7^s$. Find the chronometer correction at noon, having given $\delta = -5°\ 46'\ 22{\cdot}5''$, $\Delta\ \delta = +\ 58{\cdot}10''$, and equation of time $= +\ 11^m\ 35{\cdot}11^s$. 14

12. Deduce formulae for reducing observations of the moon at culmination to the transit of the centre. 15

13. Give the method in full for reducing circum-meridian altitudes for the determination of latitude. 15

SYSTEM OF DOMINION LANDS SURVEYS; TOPOGRAPHICAL AND EXPLORATORY SURVEYS.

(Time 3 hours.)

Marks

1. Show derivation of formulæ in the Manual for radius of curvature and normal to the meridian.

$$R=\frac{a\,(1-e^2)}{(1-e^2\,\sin^2\phi)^{\frac{3}{2}}} \qquad N=\frac{a}{(1-e^2\,\sin^2\phi)^{\frac{1}{2}}};\ \text{also of}$$

$$\log\,(N\,\sin\,1'')=\tfrac{1}{3}\,\log\,(R\,\sin\,1'')+\tfrac{2}{3}\,\left\{(\log\,a+\log\,\sin\,1''+2\,Mn)\right\}$$

where M is the modulus of the common system of logarithms, and $n=\frac{a-b}{a+b}$. 25

2. In observing for time in the vertical of Polaris, show derivation of formula $p=P\,\sin\,(t-t')+\frac{P^2}{2}\,\sin\,2\,(t-t')\,\tan\,\delta$, where p=arc of great circle from the pole and perpendicular to above vertical; P=polar distance of Polaris, δ=declination of time star; $(t-t')=(a-a')-(T-T')$ in which T and T' are the chronometer times respectively of the time star and Polaris when observed, and a and a' their ascensions. 25

3. A Peace River Block in B.C. lies along the 120th meridian; its northern boundary is the 23rd Base Line, and its southern boundary, the 20th Base Line. The 23rd Base Line extends to the 122nd meridian, while the other Base Lines are of the same length. The Block is supposed to be surveyed under the Fourth System of Survey. What is its area and what is the distance from the western end of the 20th Base Line to the 122nd meridian? 25

4. In the above Block a straight line is run for 40 miles from the intersection of the 20th Base Line with the 120th meridian, and with an initial course of N. 25° W. Give the exact position of the end of the line with reference to section, township and range. 25

5. If the eastern boundary of Manitoba is extended by a line running from the N.E. corner of the province to the most easterly point of Island Lake, and thence by a straight line to the intersection of the 89th meridian with the shore of Hudson Bay; explain fully and lucidly the method, instruments employed and checks adopted for an exploratory survey prior to the definite location of the boundary. 25

6. (*a*) Compute the difference in latitude between the middle points of the chord and arc of a township side in latitude 49°.

(*b*) What is the theoretical width of township 26 along the Correction Line and adjoining the 4th Initial Meridian to the East? 25

SESSIONAL PAPER No. 25b

THEORY, CONSTRUCTION AND ADJUSTMENT OF INSTRUMENTS.

(Time, 3 hours.)

	Marks.
1. Describe the construction and adjustments of the registering transit micrometer.	20
2. Explain the adjustments of the zenith telescope.	15
3. What is a collimator? How is it adjusted and what are the different purposes for which it is used?	20
4. Explain why two images of the same object cannot be made to coincide in the telescope of a sextant if the index glass is in perfect adjustment but the horizon glass is not perpendicular to the plane of the sextant. Explain also how it is possible that such coincidence may be secured if both the index and horizon glass are inclined. Why is it advisable to make certain of the index glass adjustment before adjusting the horizon glass?	25
5. Prove the law of extreme path for a single refraction of a ray of light.	25
6. Prove that in an achromatic combination of positive focal length consisting of two thin lenses, the lens with the smaller dispersive power has a positive focal length, the other lens having a negative focal length.	25
7. Prove that in a telescopic system the magnification is equal to the ratio of the entrance pupil to the exit pupil.	20

GRAVITY AND TERRESTRIAL MAGNETISM.

(Time, 3 hours.)

	Marks.
1. Define acceleration, force, work, activity. What are their dimensions in terms of the units of length, mass, and time?	16
2. What is the difference between British units and C. G. S. units as used in measuring magnetic force? How is a force expressed in one set of units transformed to the other?	20
3. How do you explain the fact that though an iron ball weighing ten pounds is attracted towards the earth by a force ten times as great as is one weighing one pound the two balls when left free to fall side by side reach the ground together?	12
4. Explain fully the method of observing with the pendulum to determine the force of gravity, stating the sources of error, and the precautions which must be taken to avoid or correct for them.	20
5. How does the force of gravity vary at different places on the earth's surface?	12
6. Explain the use of the magnetometer to determine the horizontal force of the earth's magnetism.	20

METEOROLOGY, GEOLOGY AND MINERALOGY.

(Time, 3 hours.)

Marks.

1. Describe a good form of normal barometer, state the different sources of error in its indications and explain how each is dealt with. 15

2. How is an anemometer rated? 10

3. Explain the influence of the rotation of the earth on the direction of the wind. 10

4. How is evaporation measured? 10

5. What are the general characteristics of metamorphic rocks? Mention some of the varieties. 10

6. What is the nature of fissure veins and what structure do they assume? Give the meaning of the terms "hanging wall," "foot wall," "Gossans," "stockwork." 10

7. Classify mountains according to their structure and origin. 10

REPORTS OF SURVEYORS

GENERAL REPORTS OF SURVEYORS

1908-1909

APPENDIX No. 13.

REPORT OF C. F. AYLSWORTH, Jr., D.L.S.

RESURVEYS IN EASTERN MANITOBA.

Madoc, Ont., February 24, 1909.

E. Deville, Esq., LL.D.,
Surveyor General,
Ottawa.

Sir,—I have the honour to inform you that according to your instructions dated April 4, 1908, I left Madoc on April 6 for Winnipeg after having communicated with my assistants and interviewed some prospective members of my party.

I arrived in Winnipeg on the 12th and proceeded to organize a party and purchase supplies. After completing those preliminaries we proceeded to Beausejour.

Beausejour is still growing, Mr. Keilbach the manager of the Beausejour glass works still has confidence that he can produce a good quality of glass there. His original equipment for manufacturing glass was not a success. He discarded it and installed a new and revised process and has engaged American employees who have had experience under conditions similar to those existing at Beausejour. He is confident that he is now proceeding along lines that will ultimately prove successful. As the alterations were not completed when I left I cannot give an opinion as to his prospects under the new process.

The assistants joined the party here, and helped to put the transport and camp equipment in order. After being delayed four days on account of rain and snow we left Beausejour on April 28 for township 16, range 7, east of the principal meridian over a road that the heavy storms had rendered almost impassable. On the 21st, a week previous, I passed over this road en route to township 16, range 8, and it was then as hard and smooth as an asphalt pavement. It was almost incomprehensible that a four days' storm could work such a transformation. About two miles out from Beausejour one of the wagons went down in the mud. When we were extricating it our provisions became strewn in the mud and the wagon box partially filled with water. The gumbo stuck to the wheels and accumulated to such an extent that it crowded against the wagon box and stopped the horses about every ten chains. We removed the gumbo with shovels and proceeded again.

As it was the first work for the horses after leaving their winter quarters they had not much strength to meet such heavy demands. They were not accustomed to their collars, and it was no surprise that they were balky. Surveyors' work is a training school to produce balky horses. We proceeded wearily along, the surveyor and the members of his party being not in much better condition than the horses. With new clothing and new boots, not worn sufficiently to become fitted, we also became weighted down and had to stop every now and then to remove the mud from our feet.

Then another team became "hung up" in the mud and we had to "double up" by hitching another team ahead in the hope that the latter team could find solid footing. Then every body shoved and pulled only to find that all four horses had become mired in the mud. In the end we were compelled to portage the load across the muskeg on our backs; we then extricated the wagon, loaded it up again and prepared to proceed when we found that the other wagons had to be handled in the same way. By noon we were all covered with mud and wet through, the surveyor himself presenting the least attractive appearance as he was leader, guide and instructor in all the movements; otherwise delays and losses would have been caused by discussion among the members of the party as to who should perform the work. If the surveyor in such cases is fortunate enough to have a time-tried, reliable teamster, he is relieved of much of this labour, but as the teamster who had been with me for over eight years found a more suitable position during the past winter, I can assure you I missed him when the whole responsibility fell upon me. After proceeding in this laborious fashion until evening we found a dry clean spot for camp on the north boundary of township 14 on the west bank of Brokenhead river. Both men and horses were exhausted when we arrived there and felt more like prostrating ourselves upon the grass than putting up our tents. But we did put them up, and decided to lay up for physical repairs for men and horses the following day. Then on Thursday the 30th we proceeded, and to the delight of all, we found that the recent storm area had not extended any farther north and that the roads now, except in the sheltered bush where they were not exposed to the drying influence of the sun, were dry and passable. Especially was this so in township 16, range 7, where we passed over a sand ridge trail, to the west side of Gull lake on sections 35 and 36 where we camped. We found this whole district had been recently overrun by a prairie fire, causing the pasture to deteriorate, which at best is indifferent on the jackpine sand ridges. We were compelled to supplement the pasture by providing other feed for the horses. The poor condition of the roads to Beausejour rendered it comparatively expensive to freight supplies from there.

We completed the resurvey of township 16, range 7, east of the principal meridian; the work was very laborious, as on account of the muskeg nature of the area to be surveyed, we were unable to locate a camp at a central point, and were thus subjected to very long walks over tamarack muskegs. I did not resurvey sections 29, 30, 31 and 32 as the necessary preliminary steps had not been complied with on account of the incorrect information the year previous to the effect that no one lived on those sections; whereas sections 31 and 32 at least are occupied.

As I have already written you, if these sections are resurveyed in the future, care should be exercised in the survey, as the original blazed lines for the north half of the east boundary of sections 35, 34 and 32 intersects the north boundary of these sections from one to three chains east of the posts where they should intersect.

Already the settlers have chopped out a road for the east boundary of section 31 and no doubt it will be found to be located in the wrong place, as it is probable the original blazed line was followed, instead of adhering to the posts. The post for the northeast corner of section 31 stands between two and three chains west of the original surveyed line for the east boundary of the section.

As usual we experienced no difficulty in finding the original posts and lines in this township; which we completed May 23.

On account of unfair weather and the moving of camp we were delayed in commencing work in township 17, range 8, east of the principal meridian, until May 30. About half the area we subdivided in this township consists of hilly jackpine sand ridges and the greater portion of the east half of the south half of the township consists of open muskegs and tamarack, spruce and cedar swamps. I have been told that the cedar was taken from here to construct the buildings of the Hudson's Bay company at Fort Alexander many years ago, and there is considerable of it in this swamp yet. But now that the lines have been resurveyed and the public have become acquainted with this fact, it will scarcely survive this winter.

Another (which I will term a forestry) phenomenon was observed by us in 1907 when we found mountain ash growing in the bush remote from settlement present or past, on the east boundary of section 14, township 16, range 7, east of the principal meridian. On June 22 we completed the resurvey of the south half of township 17, range 8, and on the 23rd left for township 16, range 1, which I was instructed on May 4 by you to resurvey. Passing through township 16, and part of 15, on the road between ranges 7 and 8, we found the road on account of recent heavy downpours of rain to be in an almost impassable condition. From there on we found the roads ideal compared with what they were in the spring.

During the progress of this trip we were afforded an excellent opportunity of observing the promising condition of the crops which were of rank growth and presenting that rich green luxuriant appearance so gratifying to the beholder. Never before in the history of Manitoba were the necessary conditions all complied with so faithfully for a successful crop. When the wheat began to head out the farmers began to complain of drouth, and the burning up, on account of the intense heat and hot winds. But with all the calamities of dry weather the farmer who had tilled his land industriously and intelligently reaped a good reward; the farmer who conducted his farming operations indifferently suffered the consequences of a poor crop. The latter condition was painfully apparent in that old settled district lying between Stonewall and Balmoral. One could detect instantly the laggards in the agricultural ranks when the seed was being planted and when the resulting crops were being gathered. So in this particular instance it was only the indifferent farmers who suffered by this drouth calamity.

We arrived at, and camped on, section 2, township 16, range 1, on July 2. We completed the resurvey of this township. The soil is of an inferior quality, although the hardy settlers who are already on the land are well satisfied, and will doubtless give a good account of themselves as farmers in the future. Generally speaking they all have good positions and work in the city most of the time, but their families are on their homesteads here. They complain bitterly about the lack of interest the provincial and municipal authorities take in providing them with roads and schools. But from my observation of them they will not abide by this adverse condition of their affairs long as they are quite capable of looking after themselves. The provincial authorities recognized their necessities by sending in an engineer to take the levels for proposed roads, and it is to be hoped that this will soon be followed by actual constructed roads and ditches, to provide them with means of ingress and egress at all seasons of the year, and to relieve the farms of surplus water. At present diving suits would be the proper equipment while travelling through many parts of the township during rainy seasons and periods. This township may be reached by one of the finest graded roads in Manitoba, some parts of which are gravelled. It is the favourite rendezvous of Winnipeg motorists.

After the completion of the resurvey of this township on August 27 we moved to section 20, township 11, range 7, which we had instructions to resurvey. Whatever is the reason, there are very few settlers in this township. Perhaps now that the landmarks may be found, some interest may be taken in it as there is much poorer land than this occupied throughout the Northwest. The Winnipeg and Lac du Bonnet power line runs almost diagonally across this township. It is nearly denuded of useful timber.

On October 15 we completed the resurvey of this township and then proceeded via Beausejour to the northwest quarter of section 14, township 12, range 5, where we surveyed the north boundary of section 15. We were compelled to survey five and a half miles of section lines in order to locate the corner of this one line a mile in length. We established properly all the corners that we visited or passed.

I have no hesitation in recommending the completion of the resurvey of the balance of this township. We completed this survey on October 23, and on the 24th left

for township 18, range 3, west of the principal meridian. On the 31st we arrived at and camped on, section 15. We found the roads simply superb leading to this township and made the resurvey without any difficulty. We unexpectedly found the original survey very well performed indeed. There are only a few settlers in the township; there is very little wood and the soil is not of first quality.

All the settlers, mostly Icelanders, are occupied considerable of their time fishing either in lake Manitoba or lake Winnipeg.

I used the angle iron posts in this township as they were mislaid by the railways and only reached me in time for this survey.

We completed the resurvey on December 10, broke up camp on the 11th, discharged all the party except the two assistants and returned to Winnipeg.

On Monday the 14th, accompanied by the two assistants, I left by train for Gimli en route to Hnausa to survey the Baldur school site on the southeast quarter of section 21, township 22, range 4, east of the principal meridian, according to your instructions. We completed this on Saturday, December 19, and immediately left for Winnipeg. After completing the balance of the business there, I left for home where I arrived on December 26.

The season was very satisfactory for survey operations with us, and as I am sure my returns will reveal, we took every advantage of it.

In conclusion, I may be permitted to point out that the innovation of appointing two assistants on my survey party during the past season proved entirely satisfactory to me, and I trust that in the future the same policy will be continued, because it enables a surveyor to perform more and better work, especially in the case of resurveys where such a wealth of detail is involved.

I have the honour to be, sir,
Your obedient servant,

C. F. AYLSWORTH, Jr., D.L.S.

APPENDIX No. 14.

REPORT OF DAVID BEATTY, D.L.S.

SURVEY OF PART OF THE BOUNDARY OF PORCUPINE FOREST RESERVE.

PARRY SOUND, February 25, 1909.

E. DEVILLE, ESQ., LL.D.,
Surveyor General,
Ottawa.

SIR,—I have the honour to report that under your instructions of May 21, 1908. to make a survey of the outlines of Porcupine forest reserve, I left home on June 8 for Winnipeg, where I remained two days purchasing supplies. I then proceeded to Battleford for my outfit which I had stored with the Hudson's Bay company and from there went to Prince Albert expecting to secure men who were accustomed to using pack horses. I was, however, unable to get any and proceeded to Swan River settlement where I met Mr. Evans, my assistant, hired my survey party, bought teams and wagons and went into camp waiting for my outfit from Battleford which did not arrive till the morning of June 27. On the 28th I started with my party for the northeast corner of township 38, range 30. From Swan River I had about four miles of graded road, then an old wagon trail to the crossing of the Manitoba boundary in township 38 between ranges 29 and 30, and from there I cut a new trail about five miles to the northeast angle of township 38, range 30. About ten miles of the road from Swan River was fairly good wheeling and then the country became low, flat and wet; the bridges across the streams were all gone and had to be rebuilt as well as having to brush many low places. From the northeast corner of township 38, range 30, I established the southeast corner of township 39, range 30, as directed in your instructions, having first observed Polaris at eastern elongation for magnetic variation which I found to be 18° east. From the sotuheast angle of township 39 I ran the south boundary 270° across range 30, establishing and building the several section and quarter section corners and continued the line across range 31 without blazing as a trial line. I then went through to the southwest angle of township 39, range 32, on the second meridian, ran the south boundary of this township 90° 06′ and found that my line was 13·79 chains south of the trial line that I had run across range 31. I ran the south boundary of township 39, range 31, 88° 26′, allowing 18° magnetic variation, connecting with the southeast angle which I had already established. Going west from my starting point I was able to make a wagon road only to within about eight miles of the second meridian on account of muskegs extending too far both north and south of my line and was obliged to move my camp and supplies by packing for the balance of the survey through to the second meridian. About one-half of ranges 30 and 31 appeared to be muskeg and swamp with small spruce and tamarack. I returned to my starting point on August 19 and commenced to survey north and east; the north boundary of section 7, township 39, range 29, crosses Whitefish lake leaving eight or ten chains of the lake in the reserve. While camped at the lake a few very good whitefish and pickerel were caught; the lake has an area of about three square miles. Working east and north around the reserve to the northeast angle of township 41, range 27, I found the country similar to that in ranges 30 and 31, viz., about one-half muskeg and swamp

with much dead timber on the ground causing a lot of work to make a wagon road; about three-quarters of my time was spent in making a road. I cut a road from the southeast corner of township 40, range 28, about eight miles south to connect with a lumberman's road which saved many miles of bad road in getting in my supplies from Swan River. The whole country has been burnt over about twenty years ago and dead timber is piled high in many places. Snow fell on November 9, 10 and 11, to a depth of about twenty inches. After working a few days longer, I found it very unprofitable making roads through the fallen timber in the deep snow and decided to discontinue the survey. The road is cut to section 24, township 41. Bell river crosses the boundary flowing eastward in section 36, township 41, through a gully about one hundred and fifty feet deep. I saw no merchantable timber along the lines of survey. There are no minerals or quarries, and the only game I saw was moose.

I have the honour to be, sir,
Your obedient servant,

DAVID BEATTY, D.L.S.

APPENDIX No. 15.

REPORT OF P. R. A. BELANGER, D.L.S.

INSPECTION OF CONTRACTS IN EASTERN MANITOBA.

OTTAWA, February 27, 1909.

E. DEVILLE, ESQ., LL.D.,
Surveyor General,
Ottawa.

SIR,—I have the honour to submit the following general report of my operations during the past season, in connection with the inspection of survey contracts and the verification of the traverse of Winnipeg river and Pinawa channel.

On receipt of your instructions dated March 28, 1908, I made my preparations for departure, and left Ottawa on April 5 for Edmonton where I had to procure my outfit which was stored in that vicinity after the close of last year's operations.

Arriving at Edmonton I experienced unavoidable delay in securing a car for the shipment of the outfit to Lac du Bonnet, and could not leave Edmonton until the 21st.

I reached Winnipeg on the 23rd, proceeded to hire my party, and spent the following three days in organizing the same and buying supplies. On the 28th I boarded the train for Lac du Bonnet.

On my arrival at this place on the evening of the same day, I found I would be delayed, as the ferry boat was out of order, and finding it impossible to use my horses for transport, I had to secure boats for this purpose. After procuring the only one available, at Lac du Bonnet I left for the site of the Winnipeg Electric Railway Company's power plant situated on Pinawa channel where I secured the remainder of the boats necessary for the work and proceeded at once on my journey up Pinawa channel and Winnipeg river to Slave falls where after a couple of days of arduous work rowing up the rapid stream I pitched camp near my initial point, the south boundary of township 15, range 14, east of the principal meridian where it intersects the right bank of Winnipeg river, and from May 7th to 15th I was engaged in traversing both banks of that portion of the river between the south and east boundaries of township 15, range 14.

Having fulfilled the first part of my instructions I returned by boat to Lac du Bonnet where I spent the two following days waiting for a car to transport my outfit to Gimli. I reached that place on the 19th.

A heavy rain having set in I left the party there and proceeded to Winnipeg to inspect the iron posts, according to your instructions.

Returning to Gimli, I found it impossible to move camp on account of the continuous heavy rains and very muddy roads, the former being so heavy that the country was flooded and bridges carried away.

During this wet interval my assistants and myself were kept busy copying notes, making plots of Winnipeg river, organizing a pack train and making arrangements to leave my wagons behind, as it was impossible to proceed with them.

On the 26th the rain having ceased I left Gimli for Tyrrell's contract of 1907, and after travelling for three days in water and mud up to the knees, I arrived there on the evening of the 29th and pitched camp in township 24, range 2. I was engaged on the examination of this contract from May 30 to June 11 and then returned to Gimli.

Arriving there, I sent a flying party composed of one assistant and three men to examine the mounding in Tyrrell's contract of 1906 at Lac du Bonnet; with the remainder of the party I proceeded to St. Boniface arriving there on the 18th, where I was compelled to wait until the 22nd for the arrival of the flying party I had sent to Lac du Bonnet, they having been delayed by the very heavy rains which prevailed during the whole time of their absence causing them great hardship and suffering, while carrying on this work.

The following day, I left via the Dawson road with the party to examine Molloy's contract of 1907, covering eight townships in range 15; we camped in township 6 of that range on the 29th. The inspection of the northern part of this contract occupied seven days, after which I returned to Ste. Anne, where I left my transport outfit and boarded the train for Gravel Pit Spur siding, and spent five days more examining the southern portion of the contract.

On July 19, I reached Ste. Anne, leaving there the next day for Lac du Bonnet, according to instructions, to verify the position of a witness mark on the east boundary of section 12, township 15, range 13, which work necessitated long arduous travelling on foot over a very marshy, mossy and rocky country in extremely hot weather. Being obliged to sleep in the open I was pestered with flies.

After this work I proceeded to Oak Point settlement which place I reached on August 1, and finding I would be unable to take my supplies by land on account of the bad state of the roads, I hired a sail boat to take the bulk of them and some of the party to Moosehorn bay, and sent on my wagons light in charge of three men to meet me there. I was delayed in sailing, by calm weather and contrary winds and could not reach the bay until the 9th.

Here, I was employed thirteen days in inspecting Teasdale's contract of 1907 which extended along lake Manitoba, north, south and east of Moosehorn bay.

From this contract, I crossed the lake to Crane bay to examine Fawcett's contract of 1907, which kept me busy until September 12, after which I returned to Moosehorn bay P.O. via 'The Narrows' and secured my mail, but was delayed till the 19th waiting the arrival of my supplies. I then proceeded with the examination of the western part of Teasdale's contract of 1908 which was ready for inspection, and I was occupied at this for nine days, reaching Oak Point on October 4, where I awaited a reply to my telegram respecting final instructions, after receipt of which I proceeded once more to Lac du Bonnet, via Stonewall, from which place I took the train with my party, and sent my transport outfit to St. Laurent for safe keeping until I should again need it; I arrived at my destination on the 10th.

After a good deal of trouble in securing boats, rowing up Pinawa channel and the river, and portaging over many falls I reached the initial point for the continuation of the traverse of Winnipeg river on the 16th.

During the next two months I was employed in traversing both banks of Winnipeg river across part of township 14, range 13, and across the whole of townships 13 and 14, range 12, and townships 15 and 16, ranges 14 and 15 together with both banks of Pinawa channel across township 14, range 12, all east of the principal meridian. After the completion of this work I proceeded to inspect Tyrrell's contract of 1908 reaching Fisher river in township 25, range 1, west of the principal meridian on December 25.

This occupied fifteen days and my intention then was to complete the inspection of Teasdale's contract of 1908, but finding that my provisions were running short and being unable to secure a further supply in the locality at any cost, and on account of the impossibility of securing feed for my horses, I had, to my great regret to leave that part of the contract unexamined. I therefore returned to Oak Point where I dismissed part of my party and then proceeded to St. Laurent to deliver over my outfit for the winter, after which I left for home via Winnipeg where I discharged the balance of my party and settled up outstanding accounts, reaching Ottawa on February 2.

The detail of my inspection is given in the reports on the separate contracts. The contractors' work in general, with one exception, proved satisfactory. It is hardly necessary for me to give any extended report of the country inspected, as I consider that the surveyors who have seen every mile of the townships covered by their contracts are in a better position to furnish such a report; however I might remark that from my observations, the country is not at the present time ready for immediate settlement. being mostly covered with bush or heavy scrub, but some homesteads are to be found in scattered localities, principally in Teasdale's and Tyrrell's contracts, and no doubt when the country becomes opened, either by fire or otherwise, so that evaporation may take place, it will be very suitable for settlement in many places, provided proper roads are built to assist its development.

Some hardy colonists have already reached this latter section, perhaps attracted by the great quantity of game of all kinds which abounds, the tracks of which are to be seen in every direction. Herds of elk and numbers of moose and smaller animals appear to have selected that country as their breeding ground.

Waterfowl and fish, though not so abundant as in the early days are still to be found in large numbers in all the lakes and streams.

There are three main routes of access to this part of the country, the Colonization road to Fisher river, the road from Oak Point settlement to Fairford via 'The Narrows' and Moosehorn bay, and the road from Gimli via Hnausa to Fisher River Indian reserve, but the first would require to be extended from Fisher river a few miles northerly where it would connect with the transversal roads opened by the surveyors, and considerable improvements should be made on that part already opened, in the shape of bridges and grading.

The second and third, in their present state, are practically winter roads, which can be used only in summer time by light vehicles, there being no bridges and the road in places passing through the lake and over swamps which need to be graded. The best means of access to the west part of the country just described is by boat via lake Manitoba which is the route most generally used in the wet season by the settlers already located there.

No indications of minerals were detected in the country I traversed.

The principal resource of the country covered by Molloy's contract as far as I could judge is the timber which can be converted into pulp or lumber, the best part of which, I am told, is in the Sprague timber limit in township 1, range 15, where large spruce, cedar, tamarack and poplar of first quality is found in great quantities. Access to this part of the country is obtainable via the Dawson route and Canadian Northern railway, on which a station called 'Gravel Pit Spur Siding' is situated in that township.

As to Fawcett's contract, having reached it by water route via lake Manitoba and Crane bay, I am not in a position to state the best means of access by land.

Along Winnipeg river, a great deal of activity is noticed in the construction of dams, the blasting of channels, &c., in connection with the Winnipeg Electric railway and the City of Winnipeg Power company's works. The latter, for the purpose of installing their plant during the coming summer, at Pointe du Bois falls, during the course of last year, constructed a railway from Lac du Bonnet to that point, and the former, having built their plant on Pinawa channel and constructed a transmission line to the city of Winnipeg, are continually improving their power by means of dams in Winnipeg river and the blasting of channels to increase the water pressure. This blasting has greatly increased the volume of water passing through Pinawa channel, and caused some change in its shore lines by the widening of the bed of the stream and the flooding of its banks for many chains in width in low places.

The country on both sides of the river was formerly well covered with large timber, a great portion of this has already been cut, but there still remains a great quantity suitable for building or pulp purposes.

As already reported by different surveyors and explorers there are on this river numerous important falls where good water-powers could be developed other than those already utilized. There is also abundance of fish principally of the sturgeon variety.

Climatic conditions may be said to be practically the same as in the neighbourhood of Winnipeg.

During the course of my operations I experienced unavoidable delays caused by the inclemency of the weather during the first part of the season, the numerous moves from one contract to another, the multiplicity of change in transport and the uncertainty of the winds in connection with my moves by water routes, notwithstanding which, I consider that I accomplished as much work as could be expected under such circumstances.

Before closing this report I might say that my assistants rendered me good service, being at all times ready to fulfil their duties with a desire to please, and proved to be well qualified for their positions.

I have the honour to be, sir,
Your obedient servant,

P. R. A. BELANGER, D.L.S.

APPENDIX No. 16.

REPORT OF E. R. BINGHAM, D.L.S.

SURVEYS AT THE PAS.

FORT WILLIAM, ONT., Sept. 9, 1908.

E. DEVILLE, Esq., LL.D.,
Surveyor General,
Ottawa.

SIR,—I have the honour to report that in accordance with your instructions of August 10, last, I left Fort William on the 16th for the Pas to make a survey of that settlement in company with Mr. H. Finger.

During the few minutes the train stopped at Dauphin we interviewed the officials of the Canadian Northern railway with regard to obtaining transport from Hudson Bay Junction to the Pas over their partially constructed line. These officials stated that we could obtain hand cars at Hudson Bay Junction, or, better still, that Mr. Dart, lumberman, of Erwood, had a gasoline rail motor car, and that he would no doubt be able to take us to the Pas.

We arrived at Hudson Bay Junction very early on the morning of August 18. As soon as we were able to get the agent up we enquired as to the handcars, but learned that none were there. Two were at the Pas, but as the company's telephone line to that place was down, they were inaccessible. We then telegraphed to Mr. Dart and arranged for him to take us to the Pas, provided we could obtain permission for him to run from Erwood to the Junction. We telegraphed to the Canadian Northern railway officials at Dauphin, but in spite of our previous conversation with them, we were unable to obtain this permission. Mr. Dart brought his motor by express to Hudson Bay Junction on the morning of the 20th and we left immediately for the Pas, arriving there the same evening. During the evening I enquired for men to assist in the survey of the settlement, and was able to commence work in good time on the following morning, continuing the work on the 22nd, 24th and the early part of the 25th.

I laid out six lots between the easterly limit of Block 'A' and the westerly limit of Block 'B' of the Pas Indian reserve. The easterly limit of the settlement extends back southerly eighty chains from the south bank of the Saskatchewan river along the easterly limit of Block 'B' and its production, the rear line running westerly therefrom, parallel to the line previously run by Lewis Bolton, D.L.S., and approximately parallel to the south bank of the river, to the easterly limit of Block 'A.'

On the afternoon of the 25th, I left, with others, returning to Hudson Bay Junction on a hand car with a broken cogwheel, which a crew of four Indians, afterwards increased to six, were unable to propel without repeated assistance from the other members of the party. However, we reached Hudson Bay Junction on the 26th in time to catch the evening southbound train. I arrived in Fort William on the morning of August 29.

Although rails have been laid from Hudson Bay Junction to the Pas, the track is ballasted for only about a third of the way, partially about another third, and un-

ballasted for the remaining distance. Many bad sun kinks hidden by tall weeds added considerably to the excitement of travel, particularly at night.

Previous reports have dealt fully with conditions at the Pas. A few settlers have gone into the townsite of the Pas and a boarding and bunk house has been opened up. The settlers are fully alive to the future importance of the place when the Canadian Northern railway will have been completed into the town, the construction of the railway to Fort Churchill commenced, and active operations begun by the lumbering interests which will inevitably centre there when shipping facilities are thus secured.

I have the honour to be, sir,
Your obedient servant.

E. R. BINGHAM, D.L.S.

APPENDIX No. 17.

REPORT OF C. E. BOURGAULT, D. L. S.

RESURVEYS IN EASTERN SASKATCHEWAN.

St. Jean Port Joli, Que., March 15, 1909.

E. Deville, Esq., LL.D.,
Surveyor General.
Ottawa.

Sir,—I have the honour to sumbit the following report on the miscellaneous surveys made by me during the past season in the province of Saskatchewan.

In accordance with your instructions of March 30, 1908, I left home on April 21 for Winnipeg where I arrived on the 27th, having been delayed one day at Montreal repairing my instrument and also one day at Ottawa getting complete instructions.

At Winnipeg I hired two men whom I took to Teulon, where I had left my outfit the previous season with Mr. W . C. McKinnell. I loaded my outfit on a car and shipped it to Yorkton where I was instructed to organize my party. While waiting at Yorkton for my outfit, which did not arrive until May 4, I hired men and bought supplies.

It took two days to repair my wagons and harness, as the tradesmen were very busy at that time, but on May 7 I moved my camp to township 20, range 2, west of the second meridian, to investigate the necessity of a retracement and restoration survey in that township.

I found an error of about one chain in the length of the north boundary of section 31, township 19, range 2 and also an error in the marking of the same line. The true chainage is 80.98 chains. I did not put any iron posts at quarter sections as all the posts ordered from Winnipeg had not arrived.

After completing the retracement of those sections needed in townships 19 and 20 I moved my camp on May 20 to township 20, range 4 and retraced the whole township. The surface is open country and the township is settled with vigorous and intelligent farmers who seem proud of the country but afraid of the summer frosts. On May 20 heavy frost occurred forming two inches of ice, and on the following day six inches of snow fell, which, however, soon melted.

The soil is suitable for all kinds of grain and vegetables, but water is very scarce, and the nearest wood fuel is twenty miles north.

On June 5 I moved my camp to township 21, range 8, where I retraced the lines of several sections in order to make them close within the limit of error allowed by the Manual.

In accordance with my instructions I made some retracement and restoration survey in township 23, range 8 and in townships 21 and 22, range 5. In this last township I ran the north boundary of section 10 and found the quarter section post to be 1.15 chains north of the true corner, but the owner of the north part of the section refused to accept any corrections.

On July 1, I went to Qu'Appelle, passing through a fairly well settled country, where good crops were seen on every side. Qu'Appelle is an old Hudson's Bay Company's trading post situated on a flat on the river of the same name between the two Fishing lakes. Little progress has been made and the streets seem deserted. I carried out the resurvey of the outline of the company's reserve according to instructions. None of the company's officials could furnish any information regarding the original survey which was made about twenty years ago. This work was completed on July 15. While working here the flies were very bad and the weather hot. I then proceeded to

township 17, range 13 to investigate the necessity of traversing Deep lake. I saw that some corrections were necessary, especially on the southeast part, so according to instructions I made a new traverse of the lake. The shores have not changed as the height of the banks is from six to twelve feet, but the water seems to be higher than formerly. This may be due to the heavy rains during the month of June.

On July 22 I moved to township 16, range 15 to determine the bearings of certain lines in order to have the blocks close within the limit of error allowed by the Manual of Survey. I resurveyed all sections mentioned in my instructions and later received instructions to resurvey the whole township, which I was unable to do as I had left the township before the instructions reached me, and was too far away to return.

I next resurveyed the north boundaries of sections 32, 33 and 34 and the east boundary of section 33 in township 14, range 9, and made corrections satisfactory to the owners of the adjoining quarter sections.

From there I moved to investigate an error at the northeast corner of section 8 in township 11, range 2. Two sets of monuments existed there and were the cause of trouble between the owners of adjoining lands. I succeeded in getting the owners of the quarter sections concerned to agree to a resurvey which destroyed one set of monuments.

On August 12 heavy frost occurred, forming ice half an inch thick and freezing all the vegetables. The early grain crops were only slightly damaged, but the late crops suffered severely.

While in township 9, range 3, preparing to do my work there I received your instructions to proceed with the survey of the Doukhobor village in township 31, range 3, and I set out at once over roads which were very bad after several days' rain, and arrived there on August 27. The first day was employed discussing the plan of subdivision with Mr. Michael White the Doukhobor interpreter. I arranged a meeting with the Doukhobors to show them the plan of the roads and all were satisfied with the arrangement except the owner of the quarter section; his land was cut into parcels by the new road. I followed the suggestions of the interpreter who explained that the road was located for the convenience of the whole village, and when the subdivision was finished and the road surveyed this formerly dissatisfied Doukhobor was as well pleased as the others.

All the houses of the village lie in rows a few feet apart, and appear to be very neat and clean. These Doukhobors are a good class of immigrants, moral, quiet and industrious. They have cultivated their lands well and appear to be proud of their crops.

On September 1, I made some correction surveys in township 30, range 3, and next day commenced a long move to township 29, range 17.

This township is well suited for mixed farming and stock raising. The water is good, wood is plentiful for fencing and fuel, and the soil is composed of a black loam and good sand. The north part is well watered by Whitewood lake. I did not traverse this lake because I had no canoe and could not obtain one in the vicinity. The shores of the lake are covered with scrub and willow and it would have taken fifteen days to complete the work. I therefore decided to return to township 9, ranges 3 and 4, to complete the work I left in August.

On my way back I made some retracement surveys in township 16, range 28, west of the principal meridian, for two settlers.

The work in township 9, ranges 3 and 4, kept me busy till the beginning of December. The weather had become very cold and I decided to close operations for the season. I accordingly stored my outfit and paid off my men and returned home, arriving at St. Jean Port Joli on December 17.

I have the honour to be ,sir,

Your obedient servant,

C. E. BOURGAULT, D.L.S.

SESSIONAL PAPER No. 25b

APPENDIX No. 18.

REPORT OF P. A. CARSON, D.L.S.

TRIANGULATION SURVEYS IN THE RAILWAY BELT OF BRITISH COLUMBIA.

OTTAWA, March 17, 1909.

E. DEVILLE, Esq., LL.D.,
Surveyor General,
Ottawa.

SIR,—I have the honour to submit the following report of my field operations on the triangulation in British Columbia, in connection with the Trigonometrical Section of the Topographical Survey of Canada, for the season of 1908. This report should be read in conjunction with my annual reports for the years 1906 and 1907.

Information having reached me early in the spring of 1908 that the winter in the Rocky and Selkirk mountains had been exceptionally mild, I decided to leave for the field earlier than usual. Consequently I set out from Ottawa for the west on May 23, a fortnight earlier than on the previous season. On arriving in the mountains, however, I discovered that although the snowfall had been rather less than the average, the spring, especially during the month of May, had been backward, and in the higher elevations of the mountain slopes and in those spots unexposed to the sun the snow had not melted very rapidly.

At Golden, B. C., where I had stored my outfit the previous autumn, I made up my party of five men, and was fortunate in again securing the services of my cook and packer of the previous season. Of the eight pack-horses which wintered in the Columbia valley, twenty-nine miles south of Golden, one had died in the early spring, but the others were all in excellent condition.

I first visited the base line in the Columbia valley, twenty miles south of Golden, and took a series of observations for azimuth with the astronomical transit, by observing on a programme of time and azimuth stars, according to the method described in Hayford's 'Geodetic Astronomy,' except that instead of one azimuth star two were observed in each half set or group. The terrestrial azimuth mark used was a lantern with a small slit, one inch in vertical height, and one-third inch wide, at a distance of one mile. The calculations were made according to Hayford's method of approximation without the use of least squares. Although this method of determining azimuths is one capable of great refinement and accuracy its use in a triangulation of a secondary character is scarcely justified, on account of the cumbersome nature of the astronomical transit, the difficulty in placing a distant terrestrial azimuth signal, the time spent in actual observing, and the lengthy reduction calculations, either with or without the use of least squares. Azimuths of the same degree of accuracy as the rest of the triangulation can easily be obtained by taking a series of observations on Polaris with the ordinary triangulation theodolite, provided the instrument will permit the telescope to rotate to a sufficiently high altitude.

Stations 'A' and 'B,' at the ends of the base line were occupied; also stations 'C,' 'D and 'E,' for the projection of the base to the main triangulation; and station 'XX.' (Beaverfoot) of the main system. At stations 'C' (elevation 8,007 feet) and 'XX.' (elevation 7,940 feet), on the Beaverfoot range, on June 24 the snow was still several feet deep, even below timber line.

STATION XXI (SPILLIMACHEEN).

From June 28 to July 6, I made a trip up the middle fork of Spillimacheen river, via Carbonate Landing, Summit lake, and the middle fork trail, advancing up the valley of the middle fork to Spruce camp (elevation 5,500 feet), about four miles from the head of the stream, and near the south limit of the railway belt. The trail up the valley was in fairly good condition, although it is now seldom used, the numerous mining prospects in this district having never been developed. There is good grass for horses along the upper portion of the trail on the many slides from the mountains.

I established and read angles at station 'XXI.' (Spillimacheen) and the secondary stations 'XXI A.' and 'XXI B.' on the peaks lying between the middle and north forks. Station 'XXI' is situated on the sharp peak of the highest mountain of this range, at an elevation of 9,410 feet. The station is marked in a permanent manner by means of a brass bolt six inches long and three-quarters of an inch in diameter with a flat head one and one-half inches square, and one-half inch thick. This bolt is set in a hole drilled in the solid rock, and firmly fixed by cement. The head of the bolt is stamped with the Roman numerals 'XXI,' followed by a triangle $\triangle$; the apex of the triangle faces north at the centre of the head of the bolt, and is the geodetic point. As reference points, two holes, one inch in diameter were drilled in the rock. The reference points are each six feet distant from the geodetic point, and bear respectively south and west from it. Directly over the brass bolt a conical stone cairn was erected, four feet in diameter at the base and six feet high. The top of the cairn is vertically above the geodetic point. A band of white cotton was wound around the cairn, about a foot from the top, to assist as a signal. The ascent to station 'XXI' was rather difficult as we did not discover the easiest route until we commenced to descend. While on the summit a severe electrical storm took place, somewhat similar to the one on Mt. Kapristo (station 'E') in 1907.

Station 'XXI B' is situated on a lower peak (elevation 8,825 feet) about two miles east of station 'XXI.' The station is marked only by a conical stone cairn eight feet high.

Station 'XXI A,' which was established by Mr. W. S. Drewry in 1891, is situated about a mile east of station 'XXI B,' on the most easterly mountain of the range being between the middle and north forks of Spillimacheen river. The station is marked only by a conical stone cairn, seven feet high, the brass bolt placed here in 1906 having been moved to the present location of primary station 'XXI.'

A reference station was also placed in the middle fork valley, being a spruce post, six inches square, and three feet long, marked 'station XXI C,' and angles were read to and from stations 'XXI' and 'XXI B.' From the positions of these stations the location of this reference post has been calculated, and may be used for commencing new surveys, or tying in mineral claims, &c., the Dominion system of surveys not having been extended to this vicinity.

During our trip up the Spillimacheen it rained on four of the ten days. On returning to Carbonate Landing we met a party of American college tourists, above twenty-five strong, both men and women, who were spending a month in the mountains ostensibly for the purpose of making a scientific study of the geology, mineralogy and botany of the district. Each year sees the Canadian Rockies becoming more and more popular as a great playground and field for students of nature.

STATION XIX A (BLAEBERRY).

It was deemed desirable to establish a triangulation station up the Blaeberry valley near the north limit of the railway belt. Consequently on July 15 a start was made from Golden up the Blaeberry pack trail. We went about thirty miles up the river, the first half of the journey being along the timbered eastern slopes of the

valley, past the Blaeberry falls and canyon, and the latter half along the wide gravel bars of the river, with frequent fordings of the main river and its numerous channels.

In the Blaeberry valley there is some of the finest timber I have ever seen, spruce, fir and some cedar, most of which is under license. Game is somewhat plentiful, bear (both black and grizzly) goat, deer, and marten, while small trout may be caught at the mouths of the small streams flowing into the Blaeberry.

We camped near the mouth of Mummery creek, a glacial stream about thirty feet wide, flowing from the west from Mummery glacier three miles back. The point is about three-quarters of a mile south of the north limit of the railway belt. The mountain on which station 'XIX A' is situated is a prominent peak, (elevation 10,000 feet) three miles immediately east of Mt. Mummery. At its base Blaeberry river takes a sharp turn from the east, and when approaching up the valley towards the north limit of the railway belt the mountain seems to suddenly terminate the valley. The ascent to station 'XIX A' was made via Mummery creek and glacier, up the westerly slope of the mountain, the apparently easier approach up the southerly ridge being broken by rock cuts and gulches, as we learned to our sorrow on attempting the descent by that route, being forced to spend a cold hungry night on the rocks. The station was not placed on the highest peak, which is rather too far back to the north, but was established on the peak visible from the valley (elevation 9,620 feet).

Station 'XIX A' is marked with the usual brass bolt set in a hole drilled in the rock, and firmly fixed by cement. The head of the bolt is stamped with the number of the station, viz., 'XIX A', followed by a triangle '△'; the apex of the triangle faces north at the centre of the head of the bolt, and is the geodetic point. As reference points for determining the position of the permanent mark at any time there were placed two iron bolts firmly fixed by cement in holes drilled in the rock, one bolt being six feet distant from the geodetic point and bearing due north from it and the other bolt five feet from the geodetic point and bearing due east from it A conical stone cairn was erected directly over the brass bolt, being four feet in diameter at the base and six feet six inches high. The top of the cairn is vertically above the geodetic point. A band of white cotton was wound around the cairn about a foot from the top to assist as a signal.

Connection was made between station 'XIX A' and a wooden post marking the northwest corner of timber berth No. 415, on the east or left bank of Blaeberry river; which post is supposed to be on the north limit of the railway belt. A base line one mile in length was established along the gravel bars of the river, and was connected to the said post of the timber berth by means of a traverse. The base line was projected to the station 'XIX A' by means of two secondary stations.

We then returned along the Blaeberry trail and made an ascent to station 'XIX' on Mt. Laussedat (elevation 10,000 feet) and read angles there on stations 'XIX A' 'XVIII,' 'XVII' 'E,' 'XXII,' 'XXIII,' 'XXVIII' and XXX A.' The ascent of Mt. Laussedat makes a very interesting climb, but after our experience of the previous year, no great difficulty was encountered. While observing on the summit I suffered intensely from the cold.

From Mt. Laussedat we returned to Golden on July 29th, the whole trip up the Blaeberry occupying fifteen days, on seven of which it rained. The remaining days were clear and sunny, with excessive heat in the middle of the day.

STATION XIV (STORM MT.)

From Golden I shipped the horses and outfit to Castle Mountain railway station, in order to occupy station 'XIV,' situated on Storm Mt. (elevation 10,300 feet) on the summit of the main range of the Rockies. On account of the tunnelling and other work being carried on by the Canadian Pacific Railway company in the Kicking Horse pass, the old tote road from Field to Laggan is now impassable for horses, and it is necessary to ship by rail between these points. A full account of the trip to station

'XIV' was given in my report for 1906, and it will be unnecessary to repeat a description here. The ascent on this occasion was much easier than in 1906, and conditions more favourable for observing on account of the absence of snow on the peak in August.

Fierce forest fires raged in the early part of August in the vicinity of Banff, about the time the disastrous Fernie fires occurred. Fortunately for the triangulation work the prevailing west wind kept the smoke from advancing westward, although the mountains to the east were completely obscured by a thick pall.

STATION XVIII (MT. MCARTHUR).

Station 'XVIII,' on the summit of Mt. McArthur (elevation 9,882 feet) was next visited, via Emerald lake wagon road, Yoho pass, and the upper Yoho pack trail. From the high elevation of our camp on Little Yoho river (over 6,500 feet) an easy ascent was made to station 'XVIII,' and angles were read under favourable conditions. The return to Field was made in one day. The weather was all that could be desired during our trip up the Yoho, which lasted five days.

STATION XVII (MT. KING).

This station is on the summit of Mt. King (elevation 9,456 feet) in the Van Horne range. A detailed account of how to reach Mt. King from Field is given in my annual report of 1906. During the occupation of this station the weather was favourable for observing, and angles were read on stations 'XIV,' 'XX,' 'C,' 'E,' 'XXI,' 'XXI A,' 'XXI B,' 'XXII,' 'XIX,' 'XIX A,' and 'XVIII.'

On returning to Field the horses and outfit were shipped to Sixmile Creek railway siding.

STATION XXX (CHERUB MT.)

From the Sixmile Creek railway siding (elevation 2,600 feet) we ascended the gradual slope of a long ridge covered with brulé and fallen timber, which extends from a northwesterly direction towards Sixmile Creek siding. We attained an elevation of 6,000 feet after a three hours steady pull for a distance of three miles; thence advance was made through the sparse timber, past a couple of small alpine lakes forming the headwaters of streams flowing into Columbia river. Continuing in a northwesterly direction we went through a pass at timber line, then along 'The Esplanade' to Sixmile Creek pass, dropping down to Sunbeam lake (elevation 6,700 feet) at the head of Spinster creek, which flows northerly into Gold creek.

During the spring and early summer a party of men engaged by a syndicate from Ohio were employed in cutting trail from Sixmile Creek siding up the north branch of Sixmile creek to some mica claims situated several miles from the mouth of Comedy creek, a confluent of the said north branch from the west. Rich deposits of excellent white mica exist all through the Selkirks from Sixmile to the Big Bend, and there now seems to be some prospect of these claims being developed. The above mentioned trail was impracticable for horses, however, although in future this route will be the better one to reach Cherub Mt., on which station 'XXX' is situated.

As far as location is concerned Mt. Sir Sandford (elevation 11,600 feet), the highest peak in the Selkirks, is a most admirable situation for a triangulation station, and I had proposed to place station 'XXX' on its summit. This mountain is at present the mecca of all alpine pilgrims in Canada, but at the close of the year 1908 all worship at its shrine had been done from afar. During 1903 two parties of aspiring alpinists attacked this majestic mountain, only to be repulsed before reaching the main peak. Sir Sandford's magnificent hoary summit rises over a thousand feet above all neighbouring mountains, and is the most conspicuous feature in this large district of prominent and majestic mountains. From the viewpoint of an alpine

climber the victorious ascent of Mt. Sir Sandford will be an honourable feat, but for a triangulation or topographical surveyor a snowless and more easily accessible mountain is the goal to be sought.

Station 'XXX' was finally established on Cherub Mt. (elevation 9,740 feet) lying between the north branch of Sixmile creek and Bachelor creek, being about three miles westerly from our camp at Sunbeam lake. The ascent of Cherub Mt. is by no means a difficult one, except for the wide névés and glaciers which must be crossed.

Station 'XXX' was marked in a permanent manner by the usual brass bolt set in a hole drilled in the rock and fixed by cement. The flat top of the bolt was stamped with the Roman numerals 'XXX' followed by a triangle, '△.' The apex of the triangle faces north at the centre of the head of the bolt and is the geodetic point. As reference marks there were set two iron bolts cemented in holes drilled in the rock. One bolt is due north of the geodetic point and distant five feet from it; the other is due east and distant six feet from the geodetic point. A conical stone cairn was built directly over the brass bolt, with its pointed top vertically above the geodetic point. The cairn is five feet in diameter at the base, and eight feet high. A band of white cotton was wound around the cairn to assist as a signal.

Besides station 'XXX' in this vicinity I also established five secondary stations on mountain peaks. These are station 'XXX A' (Cupola Mt.) elevation 8,625 feet; station 'XXX B' (Sentry Mt.) elevation 8,320 feet; station 'XXX C' (Sonata Mt.) elevation 9,830 feet; station 'XXX D' elevation 8,467 feet and station 'XXX E' elevation 8,453 feet. On account of the rough nature of the country in the vicinity of Sixmile creek and Gold creek, the valleys being very narrow and the elevations of the streams and passes extremely high, it is not at all probable that the Dominion system of surveys by means of section lines will ever be extended into this district. Consequently these triangulation stations should prove very useful for locating and tying surveys of mineral claims or timber berths.

From August 1 to 17 we had enjoyed almost perfect weather, with no steady rains, as in August, 1907. From the 18th to the 22nd the air became hazy with the dense smoke from the bush fires, rendering the mountain peaks almost invisible. On August 23 rain commenced to fall, and for eight days it rained and snowed without ceasing. From my experience in the Selkirks it would seem that each year there is a prolonged rain storm, with snow on the mountains about the third week in August.

STATION XXIX A (BUSH RIVER FORKS).

On returning to Sixmile Creek siding the horses and outfit were shipped to Donald, and we travelled to Bush river by the trail which leads from Donald to the Big Bend and Tete Jaune Cache. This trail had been repaired and cut out by the provincial authorities in the early summer and was in excellent condition. We crossed Bush river at the old crossing in a boat, the horses swimming the stream. The water in the river was considerably lower than at the same date of the previous year. We then moved by pack train along the north or right bank of Bush river, first following the shore of Upper Cygnus lake for a distance of two miles, then making our way along the bank of the river. On the whole there was very little cutting to do as we were able in many places to travel along the gravelly beach; and only when we came to sharp turns in the river were we obliged to do any heavy cutting. The most serious obstruction encountered was a rocky bluff some forty feet high abutting a rapid and deep part of the river. Over the top of this bluff we were forced to cut a trail, and we resumed progress after two hours' delay. By night we had advanced ten miles up the river, although prospectors and trappers had informed me that I could not get a pack train through. On the second day the going was even better, along the wide gravel bars of the river, which runs in several channels, in a general southwesterly direction. By repeated fordings we easily made the nine miles to the forks of Bush

river (elevation only 2,500 feet). Here the gravel bars ceased, the river below the forks running swiftly in one narrow channel, with a six-foot fall in one place. Except for a short portage around this fall, Bush river is navigable for canoes and small boats, the current running at about three and one-half miles per hour. Boats may also be used for several miles up the north fork.

This fork of Bush river which carries fully two-thirds of the water of the river comes from almost due north, and with its many confluents rises in the very heart of the main range of the Rockies, and obtains its waters from the huge ice-fields of the Columbia, Bryce and Lyell groups. The south fork is a narrow stream, about thirty feet wide at its mouth, and comes roaring from the southeast through narrow canyons over which it is almost possible for a man to jump. About a mile from the forks there is a fine fall of nearly twenty feet. The south fork drains the western slope of the Freshfield group.

Station 'XXIX A' was established on Yellow mountain (elevation 8,178 feet) lying immediately east of the forks, and commanding an unobstructed view down Bush river. The station was marked in a permanent manner with the customary brass bolt, set in a hole drilled in the rock and fixed by cement. The head of the bolt is stamped with the number of the station 'XXIX A' followed by a triangle, '△.' The apex of the triangle faces to the north at the centre of the head of the bolt, and is the geodetic point. Three iron reference bolts were also cemented in holes drilled in the rock. Each bolt is distant six feet from the geodetic point, and they bear east, south, and west respectively from it. Directly over the brass bolt a conical stone cairn was built, five feet in diameter at the base and seven feet high. The top of the cairn is vertically above the geodetic point. A band of white cotton was wound around the cairn about a foot from the top to serve as a signal.

The ascent of Yellow mountain was made by going up the bank of the south fork for a mile and a half and then climbing the southwesterly slope of the mountain, through brulé and windfall. No hard climbing was encountered, but we were without water for twelve hours. From Yellow mountain a magnificent view is obtained of some of the loftiest peaks on the summit of the Rockies—Freshfield, Lyell, Alexandria, Bryce and Columbia.

I also established a reference station in Bush valley, (elevation 2,500 feet) on the right or north bank of the river, about a mile and a half below the forks. This station is marked by a cedar post five inches square and four feet long. The post is situated in a cleared space, ten feet from the bank of the river and eight feet above the level of the water. The post is marked 'Sta. XXIX B' on one side and on another side 'Triangulation Survey in British Columbia.' From this station I observed angles on stations 'XXVIII,' 'XXIX A' and 'XXX B.'

The timber in the vicinity of Bush river forks is not very good, being mostly burnt. Game is plentiful, black and grizzly bear, goat, caribou, deer and marten. There are very few fish in the river, but in a small lake a mile below the forks, and lying between the river and the mountains to the south, we caught magnificent trout, some weighing fully five pounds.

The return to Bush river was easily made the water being much lower than when we ascended the river. The trip occupied nine days, from September 18 to 21, on three of which it rained. Each morning a heavy mist filled the valley and was not dispersed by the sun until nearly eleven o'clock. The presence of this morning mist, however, I soon learned was an augury of a fine day.

STATION XXIX (BUSH RIVER.)

From Bush river crossing I again ascended to station 'XXIX,' (elevation 8,100 feet), and observed angles on stations 'XXIX A,' 'XXVIII' 'XXIII,' 'XXX A,' 'XXX,' 'XXX B,' 'XXX C' and 'XXX D.' Very disagreeable snowy weather overtook us for several days, from September 25 to 29, during our occupation of station 'XXIX,'

STATION XXVIII (BLACKWATER).

Returning by the Donald trail, I branched off at Blackwater lake, and again visited station 'XXVIII,' (elevation 8,940 feet) observing angles between stations 'XIX,' 'XXIII,' 'XXX A,' 'XXX,' 'XXX D,' 'XXX E,' 'XXX B,' 'XXIX,' 'XXIX B,' and 'XXIX A.' During the occupation of this station, October 3 and 4, we suffered from cold and snow, and the angle readings were made under very disagreeable conditions. At our flying camp near timber line of Blackwater mountain, a grizzly bear spent a night within a hundred feet of our tent, sniffing at the fire. When we left camp before daybreak we passed within a few feet of where he lay. He sprang up at our approach, and greatly to our relief, galloped off up the mountain side.

On our return to Donald, I sent the packer with the horses to their winter range, twenty-nine miles south of Golden, and shipped the outfit by rail to Ross Peak water tank, at the mouth of Cougar creek, in the Illecillewaet valley. There I made a survey connecting the Drumlummon and Skookum mineral claims to the Dominion system of surveys, for which survey I received instructions dated May 13. I also made a visit to the Nakimu caves, and under the guidance of Charles Deutschman, explored some of the nethermost regions of those wonderful subterranean vaults. While I have no new theories to advance regarding the formation, age, or extent of the caves, it nevertheless seems to me, judging from the volume of water flowing in the subterranean torrent near 'The Turbine' and 'The Bridal Chamber,' and comparing it with the quantity which flows into the Illecillewaet via Cougar creek, that there must be some other undiscovered exit for the water, but in what direction I know not.

ANGLE READING.

The instrument used for observing angles at the triangulation stations is a direction theodolite, made from a special design by Messrs. T. Cooke and Sons, York, England. The telescope has a focal length of 15·5 inches, and the objective a clear aperture of 2 inches; the eyepiece mostly used has a magnifying power of thirty diameters. The six-inch horizontal circle is graduated to 0·25 degrees, and the readings are made by two micrometer microscopes of high magnifying power, with two parallel vertical spider wires. Five revolutions of the micrometer correspond to one division of the horizontal circle, and therefore one revolution is equal to 0·05 degrees. The milled head of the micrometer is divided into fifty divisions, and therefore one division is equal to 0.001 degrees, or 3.6 seconds of arc. The observer can interpolate to parts of a division.

Horizontal angles are read by the direction method, in most cases closing again on the horizon. Four complete sets of readings are made, with telescope direct and reversed, and motion forward and back. Between each set the horizontal plate is shifted 45 degrees to minimize the effect of periodic errors of graduation. To obviate the necessity of determining the run of the micrometer screw, the pointing on the first station in each set is made to differ from the previous pointing on the same station by one revolution of the milled head. For example, if the reading on the first station in the first set be 0.00 degrees with 0 revolutions, the pointing on the same station for the second set is made 45.00 degrees with one revolution; for the third set 90.00 degrees with two revolutions; and for the fourth set 135.00 degrees with three revolutions. By this means the same part of the micrometer screw is used at each station, and run of the screw practically reduced to zero. Both forward and backward motions of the micrometer are read on the graduations of the horizontal circle adjacent to the centre of the comb scale, and the mean of the forward and backward readings taken, the discrepancy between them being supposed to result from error in bisection. By closing on the horizon accidental errors can be traced either to errors in pointing on the signals, or to accidental movement of the instrument during the observation.

In the majority of cases the simple triangles were adjusted by the ordinary method, although where a series took the form of a quadrilateral with the angles between the diagonals also read, the rigorous quadrilateral adjustment described by Johnson in his 'Theory and Practice of Surveying' (page 549) was used. This triangulation being merely of a secondary nature, and intended for practical purposes only, the refinements of primary triangulation have not been resorted to. The horizontal angles have not been reduced to what they would have been if the stations observed upon had been at sea-level, as the reduction is very small, and the calculations for the lengths of the sides of the triangles have been made for plane and not for spherical triangles.

The theodolite is mounted on a short tripod, about two feet high, rigidly braced with cross-pieces screwed to the legs and the metal-mounted points of the legs were set in small holes chiselled in the solid rock at the station. At stations where the instrument could not conveniently be set directly over the geodetic point the distance and direction from the instrument to the geodetic point were carefully measured, and the observed angles were reduced to the true centre.

Owing to the exposed nature of the mountain peaks on which nearly all the triangulation stations are situated great difficulties to satisfactory observing are encountered. It is out of the question to erect elaborate shelters for observing, nor can heliotropes or night signals be used. The season for occupying stations of high elevations is very short, and only a limited time can be spent in observing. Owing to the uncertainty of the weather the motto to be followed in most cases is 'carpe diem.' Early mornings or evenings are the best times for observing horizontal angles, but when from three to six hours of the morning are spent in ascending from timber line to the summit, and several hours must be held in reserve for the descent in the evening, the part of the day best suited for observing is thus lost, and angles must perforce be read when atmospheric disturbances are at their greatest. At the summits, too, it is well-nigh impossible to effectively protect the instrument from the sun and wind.

Before commencing to read the horizontal angles at any station it is advisable to look for each station to be observed upon, in order that no time should be lost in finding the signals during the actual observing. Rapidity of observing is an important factor when combined with careful setting, and as little time as possible should elapse during the reading of a set of angles. When, however, a signal is temporarily obscured by a passing cloud it is a momentous question to decide whether to omit the invisible station and go on with the rest of the set (afterwards to fill in that station), or to wait until the signal can be sighted upon and risk the probability of an accidental movement of the instrument.

The lengths of the sights in this triangulation are from fifteen to twenty-five miles, and with the telescope of the Cooke theodolite excellent bisections can be made upon conical stone cairns from six to eight feet high. When a cairn on a distant mountain peak stands against the sky-line the pointed top of the dark mass of the cairn can easily be sighted upon, but where pointing is made from a high to a lower mountain, and the distant cairn has a dark background, the assistance of a band of white cotton wound around the cairn about a foot from the top has been found most serviceable. Tin signals in the form of truncated cones placed on the top of the cairn have not been satisfactory. Only on rare occasions was reflected light received from these signals, and never from more than one at a time. The tin, too, becomes rusted after a season's exposure. With the cairns for signals no correction for phase is necessary.

By means of the attached vertical circle on the theodolite the elevations of the triangulation stations and other reference points were read at or shortly after noon, when the irregular effect of refraction is at a minimum. As simultaneous reciprocal

observations cannot be made the calculations for height have to be made by the method of observations at one station only. No satisfactory determinations of high elevations were obtained by the use of aneroids.

GENERAL NOTES.

The winter of 1907-8 in the mountainous Kootenay district was fairly cold with an average amount of snow. The early spring was fine, but turned cold and wet during May. In the Columbia valley during the month of June the weather was changeable, eleven days being fair, sixteen days rainy, and three cloudy. The month of July was mostly fine in the Columbia and Blaeberry valleys, with sixteen fair days, four cloudy days and eleven days of rain, being mostly scattered showers. On the fine days intense heat prevailed in the middle of the day. August was an exceptionally fine month, especially when contrasted with the same month of 1907. Very little rain fell in the main range of the Rockies, and of the first sixteen days of the month thirteen were fair and three cloudy. The result of this fine weather, however, may be seen in the disastrous forest fires which occurred in the early part of August. In the Selkirks during the latter half of the month, six days were fair, eight rainy, and one day cloudy. On the fine days the smoke from bush fires was very troublesome. During September, in the Bush river valley, there were thirteen fair days, six cloudy and eleven days of rain. In October in the Illecillewaet valley of the Selkirks, cloudy weather prevailed, with only nine fair days. Permanent snow fell at Glacier House about October 21.

The water of the main streams during the summer of 1908 rose only to an average level. The mosquito plague was as bad as usual and seemed to begin earlier. We were fortunate in escaping the worst of that terrible scourge by a timely arrangement of our visits to the different localities. The crops in the Columbia valley in 1908 were fairly good, and fruit growing is developing rapidly, although the small fruits do not ripen sufficiently early to catch the first market, probably on account of the high elevation of the lands throughout the Columbia valley (average elevation, 2,500 feet). The fruit, when at maturity, however, is large and of excellent flavour. There has been no recent mining activity of great moment in this district, unless the probable development of some mica properties in the Selkirks.

I have the honour to be, sir,
Your obedient servant,

P. A. CARSON, D.L.S.

APPENDIX No. 19.

REPORT OF WM. CHRISTIE, D.L.S.

SURVEYS AND RESURVEYS IN NORTHERN MANITOBA.

CHESLEY, ONTARIO, Nov. 25, 1908.

E. DEVILLE, Esq., LL.D.,
Surveyor General,
Ottawa.

SIR,—I have the honour to submit the following report on my survey operations in the province of Manitoba during the past season, performed in accordance with your instructions dated April 7, May 8, and August 4, 1908.

On April 27 I started for Winnipegosis to arrange to have some repairs made to the boat which I used last year and with which I was to begin this season's work. My first work was the investigation of an error in the closing of the ninth base line across lake Winnipegosis.

On reaching Dauphin I met Captain Coffey, manager of the Northwest Fish company, in whose care the boat had been left, and arranged with him to look after the repairing of the boat, while I proceeded to Winnipeg to organize the party. From the captain I also learned that lake Winnipegosis was not likely to be clear of ice for three weeks at least.

After ordering supplies and attending to some minor details of my organization, I went to Teulon, where my camp outfit was stored, and had it shipped to Winnipegosis.

Returning to Winnipeg I completed my organization and on May 11 went with my party to Winnipegosis.

It was not until May 18, however, that the lake was sufficiently clear of ice to allow us to cross to Mr. Adam's ranch on the east shore of the lake in township 32, range 16, west of the principal meridian.

From here I proceeded to establish a connection between the eighth and ninth base lines by running a trial line north from the northeast corner of township 31, range 16. It was found on completing this connection that the error lay somewhere to the east of range 16.

Following your instructions my next step was to establish a connection between the eighth and ninth base lines by running the east boundary of range 10 between the two bases. Accordingly we started on May 30 to move across, by way of Waterhen river, lake Waterhen and lake Manitoba, to the east shore of lake Manitoba. With a favourable wind this distance could be covered with a sailboat in two days, but owing to contrary winds it took five days, so that it was June 4 when we camped on the east shore of lake Manitoba in township 29, range 10. By June 20 we had completed this connection, having surveyed the east boundaries of townships 29 and 30 and the south four miles of the east boundary of township 31, range 10, west of the principal meridian. This connection indicated that the error lay to the west of this meridian. Fairford river, which is the outlet of lake Manitoba, flowing in a northeasterly direction, crosses the line in section 24, township 30. The surface is nearly level and only a few feet above the level of the lake. Muskegs and hay sloughs are quite numerous

south of the river, but none were crossed by the line north of the river. A considerable quantity of hay, however, could be obtained around Pineimuto lake in township 31, range 9.

Fairford Indian reserve, No. 50, lying on the south bank of Fairford river, is crossed by the line. I was unable to find any monuments marking the outline of the reserve, but I was shown the approximate position of the line, and I erected no monument within the reserve.

The Hudson's Bay company have a post at Fairford. There is also an Anglican mission and school.

Most of the Indians and halfbreeds keep a few head of stock, and grow a few potatoes and other vegetables which appear to do well. During the winter they engage in fishing and trapping.

After being delayed a few days having some necessary repairs made to the boat we started on June 25 to move around Peonan point to the mouth of Boggy creek, at the north end of lake Manitoba on the ninth base line in range 13. On June 29 I began a retracement of this line. It was retraced across ranges 10, 11, 12, 13 and part of 14 where an error of nearly six chains was found in the north boundary of section 32. From this point I resurveyed the line west across the remainder of range 14 and range 15. The error in closing at the northeast corner of township 32, range 16, was still sixteen chains and sixteen links.

The country along the ninth base line has already been described and I will add nothing further here.

I next moved down to the eighth base line to check the connection across lake Manitoba in ranges 11 and 12. Here an error of seventeen chains and seventy-one links was found. This accounted for the error in closing of the ninth base line across lake Winnipegosis, but showed at the time that a large error existed somewhere to the south.

My next step was to move around to lake Winnipegosis and complete the resurvey of the ninth base line across ranges 16 and 17 as far as the west shore of Salt point, i.e., to the east shore of lake Winnipegosis proper. This was completed on July 24.

As I had no instructions for any further work I returned to Winnipegosis on July 25 and telegraphed you for further instructions.

On July 27 I received your telegram instructing me to establish the east boundary of range 17 between the ninth and tenth base lines and the tenth base line in ranges 16 and 17. This was followed by further instructions to make a connection across lake Manitoba on the seventh base line, and to survey the east boundaries of townships 32 and 31, range 16, west of the principal meridian.

After replenishing my stock of supplies I moved camp on July 28 to the east shore of Salt point in township 33, range 16, and on July 29 began the survey of the east boundary of range 17 north from the ninth base line. By September 5 I had completed the east boundary of range 17 to the tenth base line, and that portion of the tenth base line in ranges 16 and 17 between Waterhen and Winnipegosis lakes. As the iron posts required for these lines had not arrived up to the time of the completion of this part of the survey, temporary wooden ones were put in, and I returned later and put in the iron posts.

The country passed through by these lines is almost level and many large muskegs and swamps are crossed. In townships 33 and 34 considerable hay land is crossed. Farther north also in township 32, large quantities of hay can be cut. I would consider this a good stock raising locality. Very little hay land occurs in townships 35 and 36. The dry land between the swamps and muskegs is covered chiefly with small poplar, spruce and willow with old brulé in many places. Very little timber of milling size occurs along the line. Nearer the shore of lake Winnipegosis, however, which is from one-half to four miles west of the line, several bunches of larger spruce may be seen from the lake.

The alkaline water from which Salt point derives its name is confined to a narrow strip along the east side of the point, in townships 32 and 33. The water everywhere else along the line is fresh.

On September 7, I started south to make the connection across lake Manitoba on the seventh base line, and on September 9 camped on the west shore of lake Manitoba, in section 31, township 24, range 10, west of the principal meridian. On September 15 I completed this connection, having been delayed a day on account of smoke which was so thick that it was impossible to see across the lake. Here an error of nine chains and sixty links was found, the distance between the quarter section corner on the north boundary of section 36, township 24, range 10, and that on the north boundary of section 33, township 24, range 9, being nine chains and sixty links too great.

On September 16 I moved camp up to the mouth of Waterhen river, and on the 17th began the survey of the east boundary of township 32, range 16. By September 30 the east boundaries of townships 32 and 31 were completed and the jog at the correction line measured.

This meridian lies on an isthmus from two to five miles wide between lake Winnipegosis on the west and Waterhen river and lake Manitoba on the east. The surface is almost level and is covered chiefly with second growth poplar and willow with brulé. Some small hay meadows are crossed in sections 12 and 1, township 31. There is also considerable hay land along the shores of both lakes Winnipegosis and Manitoba.

On October 1, I moved camp up Waterhen river across lake Waterhen and camped on the west shore of the lake in section 1, township 37, range 16, and on the following day began putting the iron posts in the tenth base line in ranges 16 and 17 and the east boundary of range 17 between the tenth and ninth bases. This work was completed and we were back at Winnipegosis on the night of October 3 (Saturday). On Monday I discharged my party and they left the same evening for Winnipeg. Next day I completed arrangements for the wintering of the boat and attended to a few other details incidental to the closing of operations and left on the 8th for Winnipeg, arriving there on the 9th. The same evening I went to Teulon and arranged with Mr. McKinnell to winter the horses which had been in his charge since last January. On October 10 I returned to Winnipeg and left the same evening, arriving home on the 13th

I have the honour to be, sir
Your obedient servant,

WM. CHRISTIE, D.L.S.

APPENDIX No. 20.

REPORT OF T. A. DAVIES, D.L.S.

RETRACEMENT AND SUBDIVISION SURVEYS IN SOUTHWESTERN ALBERTA.

OTTAWA, February 26, 1909.

E DEVILLE, ESQ., LL.D.,
Surveyor General,
Ottawa.

SIR,—I beg to submit the following general report on retracement and subdivision surveys during the season of 1908.

Having received instructions to make a retracement and restoration survey of that part of the fifth meridian between the northeast corner of section 24, township 4, range 1 and the third base line, I left Ottawa on April 27, for Edmonton where I procured my outfit of the previous season. I then proceeded to Macleod.

From Macleod I started, with the outfit, to drive to township 4, range 1, west of the fifth meridian, and arrived at the town of Pincher Creek on the first day. That night a heavy rain began and continued for four days putting the trails in an exceptionally bad condition.

On May 15, I arrived at the place where work was to be commenced. The following morning the northeast corner of section 24, township 4, range 1 was located. Further work, however, was impossible on account of heavy rain. On May 18, the rain stopped and work was begun again.

During the latter part of May and the first two weeks in June rain fell almost continuously. Pincher creek was swollen so much that many of the fords were impassable. Under these conditions anything like satisfactory progress was out of the question.

The country on either side of the meridian through townships 4 and 5 and one mile into township 6 is hilly, generally open, with occasional clumps of poplar and willow brush or scattered spruce and pine. As this line is close to the mountains the nights there through the summer are cold and frost is likely to occur.

Cattle and horse ranching is the principal occupation in this part and throughout all the country where surveys were carried on.

Hay, both wild and cultivated, is cut from the land in the neighbourhood of Pincher creek, then baled and drawn into the town of that name. Grain also is grown over a district comprising the country two and three miles south of the railroad and from Pincher Creek west to Cowley.

North of the Crowsnest Pass branch of the Canadian Pacific railway the meridian passes over a rolling prairie broken by coulées and the valley of Oldman river. An iron bridge built recently across this river gives access to the railroad from the country on the north.

On June 25, the work on the meridian was completed and the following day we moved along a good wagon trail into township 9, range 30 west of the fourth meridian where I was to complete the subdivision begun by Mr. C. C. Smith, D.L.S., in 1907, and to retrace that part of the north boundary of the Peigan timber reserve affected by the subdivision.

Having retraced Mr. Smith's lines and finding that my work agreed with his the lines were mounded according to instructions.

The township is rough and hilly and almost covered with fir, spruce, balsam, pine and poplar, averaging from four inches to two feet in diameter. Openings are very few and small. Settlers had not come into that part of the township to the west

of Beaver creek valley, which extends along the eastern tier of sections. Those in this valley are occupied with cattle ranching. Having finished this work and surveyed four miles of line in township 9, range 29, west of the fourth meridian which I had been instructed to do we moved along a trail going southwest across the Porcupine hills to meet the main wagon road to Frank. From here a trail following the railroad to Lille led us into townships 8, ranges 3 and 4, west of the fifth meridian where the next work was to be done.

Township 8, range 4 and that part of township 8, range 3, to the west of the Livingstone range of mountains, is very rough and mountainous, densely timbered with spruce and fir, from six inches to two feet in diameter, jackpine and poplar. Many of the sidehills are covered with windfall and underbrush.

One settler had located in the western part of section 13, township 8, range 4.

On August 27, all the work that was practicable was finished and we moved to the eastern side of the Livingstone range to complete as much as was required of the subdivision of townships 8, 9 and 10, range 3, west of the fifth meridian.

A good wagon road leaving the main trail between Lundbreck and Frank follows the east boundary of townships 7 and 8, range 3.

The country along the eastern side of the range changes from level to a rolling and hilly surface. The level parts are frequently marshy ground covered with willow brush and second growth poplar. The rolling and hilly parts have scattered clumps of poplar and willow brush.

Wood for fuel can be obtained from the slopes of the range. Toward the end of September, and during the first half of October two snowstorms occurred. Eighteen inches of snow fell in both instances.

The work in these townships was finished on October 22, and we then moved north into townships 12 and 13, range 3, west of the fifth meridian, to complete as far as was practicable the survey of certain coal lands there.

A good wagon road follows Oldman river through the 'gap' in the Livingstone range and then north along the valley of Livingstone river as far as section 6 in township 12. A wagon trail continues on as far as the north boundary of township 12, but is in poor condition.

It was not possible to go east from the Livingstone valley with wagons. I therefore made arrangements with Mr. M. Bolton, a rancher in section 6, township 12, to pack the outfit, while the work was going on. A considerable amount of trail cutting was necessary to keep the camp as close as possible to the work. The country is mountainous and rough, timbered, for the greater part, with spruce, balsam, pine and poplar from three inches to two feet in diameter. The northeast slopes of the mountains are generally covered with windfall and underbrush. The summits of the hills are in most cases open country as are a few of the sidehills.

The two principal creeks of these townships are Whites creek and Falls creek, so called from the succession of small falls near its junction with Livingstone river. Hay grows plentifully enough for grazing purposes in the valleys of these two creeks.

Tracks of the different kinds of game, such as deer, lynx, bear, coyotes, rabbit, a few marten, partridge, grouse and ptarmigan gave evidence of their existence in the country.

On December 20, instructions were received telling me to close operations for the season. I, therefore, put the lines run in such a condition that they could be taken up again without interruption.

The necessity of packing ended, the wagons were loaded and drawn to the town of Pincher Creek and thence to Mr. R. Duthie's ranch, about eight miles south of the town, where the outfit was left for wintering. I then returned to Pincher and boarded the train for Ottawa.

I have the honour to be, Sir,
Your obedient servant,

T. A. DAVIES, D.L.S.

APPENDIX No. 21.

REPORT OF W. J. DEANS, D.L.S

MISCELLANEOUS SURVEYS IN SASKATCHEWAN AND MANITOBA.

BRANDON, MAN., February 22, 1909.

E. DEVILLE, Esq., LL.D.,
Surveyor General,
Ottawa.

SIR,—I have the honour to submit the following general report of my survey operations during the season of 1908, in the provinces of Saskatchewan and Manitoba.

Having received your instructions, dated May 13, in reference to miscellaneous surveys required in the province of Manitoba, I commenced at once making preparations for the season's work, but for various reasons, it was June 8 before I left Brandon with my assistants and party for Kamsack, at which place I left the horses and outfit which I had used the previous season. The Doukhobor with whom I had left the horses had taken great care of them and had all in excellent condition.

Just before leaving Brandon, I received instructions to make a correction survey in township 24, range 30, west of the principal meridian. The instructions stated that this work was required first, so, having got my outfit together and sufficient supplies for some time, I left Kamsack on June 13 to make this survey.

The original subdivision of this township is very irregular, particularly in the northwest quarter. I ran the various lines to correct the survey and made traverses of improvements acquired by reason of the change and valued the same. The settlers on section 30 adjusted the question of compensation among themselves, but not until I had made traverses of improvements. These men are well pleased and glad to have this matter settled. The settlers on section 20 are all satisfied with the new survey and the amount of compensation received for improvements lost. It was assumed that the owner of section 31 would not object to deeding the Greek Roumanian Catholic church, the property occupied by them, and which was thrown into the south-east quarter of his quarter section by the correction survey. This assumption, however, proved to be incorrect and as a consequence the boundaries of sections 31 and 32 are as in the original subdivision. All the settlers on section 32 appear to be satisfied to have the boundaries remain unchanged, so that this whole matter would seem now to be satisfactorily adjusted.

The Canadian Northern Railway company are building a line which will pass through this township and give the settlers the advantages enjoyed by communities having railway connection.

On June 29, I started for township 23, range 26, west of the principal meridian. My work in this township consisted in laying out section 6. Before I could do this, however, it was necessary to re-establish the north boundary of sections 35 and 36 in township 22, range 27, west of the principal meridian. This part of the country appears to be in a very prosperous condition, as many new farm buildings were in course of erection and road improvements were general.

On July 6, I started for Grandview. I had intended to reach this place by the colonization road across the Riding mountains, but I found it in an almost impassable condition and concluded that it would be much better to go by way of Asessippi and

Roblin. On July 9, I arrived at Grandview, and on the 10th moved camp to section 27, township 26, range 24. I immediately proceeded to carry out the surveys required in this township. While working in this place the mosquitoes were very bad, rain also interfered and delayed the work. I finished here on July 20, and next day started for Ethelbert, arriving there on the 24th.

On July 25, I moved camp to township 30, range 21. My work in this part consisted in retracing the south boundary of township 31, measuring the meridian, closing distances and obtaining the azimuths. This township is very low and wet and the trails are very bad, even in midsummer.

On August 3, I moved camp to Ethelbert and after getting supplies and making some inquiries about trails, we proceeded to section 12, township 29, range 23. My work in this township was to lay out the easterly tier of sections. These sections adjoin the Duck Mountain forest reserve. The surface is generally level and covered with a thick growth of timber and scrub with small clearances in places. There are a number of settlers on these sections who have made good progress in clearing up the land and getting it under cultivation. Wild raspberries are very plentiful along the easterly slope of Duck mountains; the settlers gather great quantities and dispose of them to the merchants in Ethelbert, who ship to Winnipeg and Brandon where the fruit commands a good price. On August 22, I finished the work in township 30, range 23, and started for Fork river by way of Ethelbert, passing through a low wet country covered with yellow scrub. The trails through this part are very numerous but none are much travelled and they appear to have no definite destination. The whole of the country between Ethelbert and lake Winnipegosis is low and flat with numerous hay marshes, separated by stony ridges. The settlers are principally Galicians, who are engaged in mixed farming. The great need of this part is drainage; a large number of settlers are abandoning their homesteads because they are unable to work the land early enough in the spring on account of water.

In township 28, range 18, I retraced the east boundaries of sections 25 and 36, also the north boundary of section 36 and traversed Dauphin lake through these sections. This completed my work in this township and on September 1 I started for township 23, range 20, passing through the town of Dauphin on the way. I arrived in township 23 on September 2, and completed the work on September 4, and next day moved camp to township 23, range 21. I completed the work there on September 9.

Having received instructions in July to make a retracement and restoration survey of township 22, range 11, I now made a start for that township, passing through Dauphin, Ochre River and Makinak on the way. At this latter place we left the railway and struck east through Ste. Rose du Lac, travelling over graded roads through a well settled and prosperous country. About eight miles east of Ste. Rose du Lac, settlement ends, and the country becomes low and wet with many extensive hay marshes and sloughs. The trail to Kinosota is but little used, only an occasional traveller or Indian passing that way, and as it runs through bush for eight or ten miles, I found that I had undertaken quite a task in attempting to reach Kinosota by this trail, but by sending men ahead with axes to clear away the fallen trees, we made fairly good progress through the bush. We arrived at Kinosota on September 16.

On September 18, I started work in township 22, range 11. This township was subdivided in 1886 and as the marks were wooden posts and bearing trees which were difficult to find on account of the lines having grown up and the posts rotted down, settlers were unable to determine where their lines were and hesitated to make improvements until their boundaries were correctly defined. A number of settlers have recently taken up land in the township expecting a railway in the near future, which is in course of construction and has now reached Sandy bay. The proximity of lake Manitoba makes this township a very desirable location for settlers as the lake is rich in fish, which affords profitable and agreeable work in winter time.

On September 25, a great storm started; the wind blew a hurricane and rain came down in torrents. This storm lasted five days and did great damage to the shipping on the lake. The Hudson's Bay company lost all their supplies which were in transit at the time. This mishap caused me a great deal of inconvenience as I was largely depending on the company for supplies, which were now at the bottom of the lake.

In October I received your instructions in reference to making a restoration survey in township 23, range 11. In the original subdivision of this township, the south boundary was not run, the subdivision lines being connected with the north boundary of township 22. I therefore ran this line and marked it in the usual way. The lines in the rear of the lake lots had never been run, the surveyor running only the section lines. I therefore ran lines in the rear of the lots marking the boundaries as on a correction line. The settlers in this township were very pleased to have their lines run as there was much uncertainty in regard to the boundaries.

On December 1 and 2 I surveyed section 6, in township 23, range 10, Roderick Flett has a homestead entry for the southeast fractional quarter of this section. He was under the impression that a number of squatters were on his fraction. I found that he himself was not on the land for which he had an entry.

On December 5, I completed all of the work in this part and on the 7th stored the outfit and left the horses with Robert De Charm who had agreed to winter them. I then hired one sleigh and a sleigh and team, and started with the men for Brandon, via Westbourne. I arrived at Brandon on December 9, and paid off the assistants and men next day.

On December 14, I started for Langenburg to carry out your instructions in reference to the correction survey in township 24, range 30, west of the principal meridian. I finished this work and returned to Brandon on December 22.

The work on which I was engaged last season consisted principally of small surveys scattered over a large extent of country. To carry out these surveys it was necessary for me to drive more than five hundred miles and often delays were caused in starting a survey through inability to find the starting point and get the necessary observation.

The new posts in my opinion are much better than the old ones. The material is superior, the shape is such that settlers will be unable to make use of it, and when placed in the ground it is difficult to turn and so it will stay in the position placed by the surveyor.

I have the honour to be, Sir,

Your obedient servant,

W. J. DEANS, D.L.S.

APPENDIX No. 22.

REPORT OF THOMAS FAWCETT, D. T. S.

RESURVEY OF PART OF THE FOURTH MERIDIAN AND MISCELLANEOUS SURVEYS IN ALBERTA AND SASKATCHEWAN.

NIAGARA FALLS, ONT., January 7, 1909.

E. DEVILLE, ESQ., LL.D.,
Surveyor General,
Ottawa.

SIR,—In accordance with your instructions for the retracement of the fourth meridian, and of the several correction surveys assigned me during the past season, I have the honour to submit the following report:

Leaving home on June 13, I proceeded to Toronto where I was joined by Mr. Paul B. Street, a student surveyor, who had been appointed by the department as my assistant and together we proceeded to the west, reaching Lacombe, Alberta, five days later. At that point I took over four horses which had been left in charge of Mr. Sam. Godfrey by Mr. A. Hawkins, D.L.S., procured a part of my outfit and men and then went on to Hardisty, leaving Mr. Street and the men from that point to travel across country to the intersection of the fourth meridian with Red Deer river, near which point we expected to begin the retracement. The country travelled over by this section of my party was for nearly a hundred miles saturated with water as a result of the continuous heavy rains which began about June 1, and continued the greater part of that month. So difficult was the travelling that even with four horses attached to a light load, the speed made was very slow, bridges having to be built, muskegs brushed, loads taken off the wagon, carried ahead and reloaded, this operation having to be repeated several times. The road followed the Lacombe-Moosejaw branch of the Canadian Pacific railway closely until Stettler was reached. The party suffered a delay the first day out through an accident. The cook, who evidently was not an expert axeman, in cutting wood for his camp fire, cut an artery in his foot, had to be taken to the nearest station, put aboard the train and sent home to Lacombe. Another man was taken on to fill the vacancy, but that left the party without an experienced cook, which is always a disadvantage. The wet road continued until a point east of Sullivan lake was reached; then the whole aspect was changed, and instead of travelling through water and muskegs all the day long it was not an uncommon thing to travel a whole day without seeing any water, good, bad or indifferent. This condition was harder on the animals than the other. About that time (the last week in June) a deluge of mosquitoes came from somewhere and made life a hard fought battle with some uncertainty as to which party should belong the victory. This condition fortunately did not continue more than two weeks, or the little winged insects might have claimed the victory over the quadrupeds and bipeds. At the end of the second week the party arrived at their destination feeling that they had come through great tribulation.

The rainy condition prevailed in the vicinity of Hardisty to the same extent as around Lacombe. This wet weather followed by an unusual warm spell gave the crops a great impetus from which a rapid growth and early maturity might confidently be expected, and from reports received later the return from the ground was very en-

couraging. Taking the Canadian Pacific railway from Wetaskiwin to Hardisty it is a revelation to anyone who has not been through that country for four or five years to see so many large towns which have sprung up, mushroom-like, but with all the stability of places with years of development to their credit. That part of the country which lies southeast of Edmonton being park-like, groves of timber alternating with open prairie spots, naturally attracts a good class of settlers who fill up such places very rapidly when once its advantages become known. Contented citizens from different parts of the United States comprise a considerable proportion of the population, and those usually come with everything necessary in the way of implements, etc., to develop the country and reap its wealth without any preliminary delays. I mention this great progress in so short a time because I was led to wonder at it, having myself travelled through a great portion of that country, and part of it many times when it would have required the most pronounced optimist to have conceived such rapid development. I reached Hardisty on the evening of June 20 (Saturday evening) when a cold rain, almost sleet, made one huddle around the fire in order to feel comfortable indoors. On Monday morning I procured a livery conveyance and a man to drive me out to Mr. Albro E. Henry's ranch to take over the Government horses and outfit left there by Mr. A. McFee, D.L.S., who had a short time previously surveyed the outlines of a large Government park which was rapidly being fenced and put in readiness for the herd of buffaloes formerly of Yellowstone Park in the United States, but purchased by the Dominion Government to make their homes once more along the banks of Battle river, which not more than a generation ago was a favourite feeding ground for those noble animals, which carelessness and cruelty had permitted to become extinct but which may at some future time become a source of revenue to our country through this transaction on the part of the Dominion Government. The farm where I found the horses adjoins the park and the trail between the railway at Hardisty and that point was at that time alive with teams drawing posts and wire for the contractor who was making a strong permanent fence to keep the animals within their own habitation. Taking over the horses and wagons and having engaged two men to accompany me on the road and to assist with the survey, we started from Hardisty on the evening of June 23, with two wagon loads of provisions and feed for horses. We started in a southerly direction travelling through a hilly country, sparsely settled, following a trail which connects Hardisty with Talbot, about thirty miles south of Hardisty where the country seems to be pretty well occupied and large areas under cultivation. Not far to the east of Talbot the Neutral hills can be seen where the people resort to for building timber and fuel. Bluffs of poplar are scattered through the country until open prairie is reached some distance south of the Neutral hills. In the rolling country passed through the soil to a great extent is a black loam over clay with an occasional outcrop of gravel and boulders. Some twenty miles south of Talbot we reach the unoccupied prairie with surface hilly but water becoming scarce in the ponds. All the way from Hardisty until well south of the Neutral hills the country at the end of June was well supplied with fresh water in ponds and lakelets, while a few miles south of Talbot two nice streams, the Ribstone and a tributary, had to be crossed. We were fortunate in finding a bridge recently completed, otherwise the crossing would have given us considerable trouble and delay, as earlier in the spring the bridges over those streams had been washed away and traffic between Hardisty and the settlement south of the Ribstone had to be suspended. Communication was at that time opened up with Stettler, the town at the terminus of the Lacombe branch of the Canadian Pacific railway.

After travelling some fifty miles southeast from where we crossed the Ribstone we descended a long incline falling about two hundred feet in a distance of one mile to Sounding creek. Along this stream are bunches of willow where travellers can find a supply of fuel. The land north of Sounding creek would be fairly well adapted for agriculture were it not so far from material for building and fuel. When the Moosejaw-Lacombe branch of the Canadian Pacific railway is completed it will open up a

large country through this district. After leaving Sounding creek we realized that we were travelling through a country where there had been no rain nor snow to amount to anything for many months. The surface is rolling and hilly, yet we drove all day and more than half the next before we came to any water. Beds of ponds and lakes were numerous but dry and the ground baked hard and full of crevices; the grass had attained very little growth and seemed parched and dry. Between Sounding creek and Red Deer river, some fifty odd miles, we discovered only one small pool of water through which the cattle from the ranches to the south had trampled hundreds of times, but as men and horses had been thirty-eight hours without any it was very acceptable. With my two men from Hardisty I reached the valley of Red Deer river on the evening of June 30, having spent a week making the trip, travelling in a direct course after leaving Talbot, striking an occasional survey monument from which the locality could be ascertained. The water in Red Deer river was at a very high stage owing to the heavy rains in the west and north at its source. The Saskatchewan also was very high but falling rapidly. I placed my camp as near the intersection of the fourth meridian with the Red Deer river as I could ascertain from the map and began the search for survey monuments. The high banks of the river on the north side are covered with boulders, and there are numerous stone mounds, so many that they were perplexing and none could be identified as the surveyor's land marks, and the country being full of ravines and broken banks one might pass within a few yards of a survey mark without seeing it. Inquiries from the few ranchers I met brought no information as they professed to know nothing whatever about any survey marks and I formed a very strong opinion that many of the original land marks had been removed or obliterated for a purpose. The country has been used exclusively for ranching purposes except for the raising of a few vegetables and oats for feed and local use, and the disappearance of all the land marks would prevent settlement for other purposes. Notwithstanding my long experience I searched for three days before I found a post that I could identify, and that was ten miles north from the river. It was sufficient to enable me to locate the meridian which when once found something remained to indicate where the original mounuments had been, and the line was easily followed but few traces of original posts remained. Sometimes a point of wood could be found and iron posts at several township corners, but section posts seemed to have disappeared entirely. On Saturday, July 4, the contingent from Lacombe arrived at camp and on Monday morning following we began the work of retracement at the point formerly located in township 25 and reached the Red Deer on Wednesday. For the purpose of carrying the line across the river I had taken my canvas boat from home, otherwise I would have had great difficulty in carrying on this part of my work owing to the high water and strong current. I had contemplated building a raft of dry logs to ship my wagons over but learning that a ferry was in operation thirty miles down the Saskatchewan I considered it the safer plan to send the teams and bulk of the outfit around, using the boat to cross the Red Deer. On the point of ground between the Red Deer and Saskatchewan I found a half-breed rancher and engaged him with his team to draw my boat and camp outfit across the point to the Saskatchewan. The point of land is mostly a clayey or sandy loam with a friable clay subsoil and would be well adapted to grow grain or vegetables if moisture were sufficient, but there seems to be a deficiency of rainfall and the land lies at too high an elevation to use water from the river. From Red Deer river to within a mile from the Saskatchewan there is a gradual increase in elevation to about three hundred feet above the river after which it descends rapidly to the Saskatchewan. Along both these streams there are flats covered with timber, in some places large cotton wood or rough bark poplar attaining not unusually a diameter of three feet. After crossing the Saskatchewan we crossed over a sandy flat and then made a gradual rise for two miles to the second crossing in section 13, township 22. The descent to this crossing is very steep with broken cut banks and ravines with clay and some

boulders. We tracked our boat around to the point of this crossing, the current being too swift to make any headway rowing. The second point of land along the Saskatchewan is composed of drift sand with very little vegetation extending west from the line about half a mile and east to the river. Slight traces of the line could be found across this point. The third crossing of the Saskatchewan is in section 1, the township corner being marked with a witness post on the south bank of the stream. From here after several ups and downs we reached an altitude of some six hundred feet on the bench and left the river which bears away in a southwesterly direction to Medicine Hat. On the evening of the third day the teams and outfit arrived at the river and accompanied the line party from here all the way down. The land for the next ten or twelve miles is mostly a light sand which in some places seems to have drifted over clay ground, clay outcrop through the sand being seen in spots. The principal trouble from this on was to find water at convenient points for camping. In township 20, just east of the meridian near the north boundary is the headquarters for Walker's ranch. Here we found a well and a pump driven by a windmill keeping a large tank well filled with excellent water, and there seemed to be no fear of the supply becoming exhausted. The water among the sand hills is usually reached at fifteen or twenty feet below the surface and if a sand point is driven down five or six feet lower there is no danger of the water supply running out. There had been very little rain here in 1907, scarcely any snow last winter and no rain in the spring worth mentioning, which caused all the surface water to vanish, but the vegetable growth appeared much better on the sand than on the clay ground; on the latter the grass was stunted and dry while on the sand it was still green. Mr. Walker had a garden with vegetables, potatoes, &c., which gave promise of a fair crop. Moisture seemed to penetrate through the sandy land when it would simply be labour spent in vain to try any crop on the clay ground. The cattle on this ranch were all in good condition and although early for marketing Mr. Walker was taking a bunch of fat steers out to the railway at Walsh for shipment to the east. The next place where water was to be had was Beatty's ranch twelve miles southwest in township 19, some six miles west of the meridian. This was in the sand hills also, and the same conditions prevailed as at Walker's ranch. Through the sand hills there is a little scrub and small patches of timber which in conjunction with the sand hills which extend in no particular direction afford sheltered spots for stock. This year those ranchers find it arduous labour to provide more than enough hay for their working teams and saddle horses. The grass having arrived at a much less growth than usual they naturally look forward to the coming winter with foreboding. Two years ago when there was a very heavy snowstorm, Mr. Walker saved his stock from perishing by running a snow plow from early morning until late at night to uncover the grass so that the cattle could graze, but this invention cannot be depended upon to render much assistance in places or in seasons where the grass is short. The next place where water was found was a lake which crosses the north boundary of township 17 about a mile east of the fourth meridian. The water in the lake itself is bitter and alkaline but in a draw near the southwest corner of the lake is a flowing spring of sparkling clear water. Horses and cattle far distant from any rancher's headquarters come here to drink. There are other springs around the margin of the lake, but the one mentioned is the best. Here the country is rolling and hilly, the soil is generally clay with gravel and boulders on many of the hills. Nine miles farther south we reached another lake crossed by the fourth meridian near the middle of township 16, where water was found in ponds, the greater portion of the beds being dry. Here we found two shepherds with their dogs in charge of three thousand sheep, the property of a company with headquarters at Many Island lake. The sheep had to be guarded day and night against the coyotes or prairie wolves which were ever on the watch to pick up any that might stray to one side. The country here being rolling and hilly is well adapted for grazing land

and many bunches of horses and cattle were seen roving at will over the prairie. Thirteen miles south of this lake we reached Many Island lake, which we found greatly diminished in area since the original survey was made. Instead of five miles across water we crossed only fifteen chains which the chainmen waded. The north side of the lake remained unchanged, but on the south side there is an extensive flat where people were making hay. The grass was coarse and poor in quality, but very acceptable in a year like the present, as it will supply feed for the sheep during the winter. There are several sheep ranches occupying that belt of land lying between the Saskatchewan and Bigstick lake in this latitude. The country covering a belt of fifty miles from the Saskatchewan eastward and twenty miles from the south side of Many Island lake northward, seems to be particularly well adapted for this purpose. The flat country where crossed by the line extends to the north boundary of township 12, a distance of eight miles. For the first few miles the soil is light sand but gradually changes to clay loam and then to a hard sticky clay which when baked by the sun is a regular gumbo. On the south side of the lake we reached a settled country where there are some occupants and some deserted houses. In townships 12 and 13 we found Boxelder creek and MacKay creek, both dry, except in small pools. This had not occurred (so I was informed) since 1892, when there was a great dearth of water all over the provinces. Township 12 is very hilly with intervening valleys and ridges. When water is plentiful in the creeks some of the flats can be irrigated and have been in former years. Many of the hills are composed of gravel with embedded boulders. Across township 11 south of the Canadian Pacific railway the country is nearly level with a substantial clay soil and would be well adapted for agricultural purposes if the water supply were sufficient. Some crops were put in which did not amount to anything this year. The earlier settlers in this part of the country did not count on raising grain in this locality but confined themselves to the stock trade both in horses and cattle. As a usual thing the land is excellent for grazing the grass being rich in nutrient qualities. In townships 11 and 10 there are a number of German settlers who came from the United States, bought lands from the ranchers with the intention of farming but have met with discouragements. The settlers in townships 9, 10, 11 and 12 went to the benches of Cypress hills to cut hay. There was no hay to be had on the low ground, grass on the benches from 600 to 1,000 feet higher being plentiful. The hills were occupied for miles by those ranchers and others from the north country, all making hay. Some of them expect to take their stock up to the hills to winter while those who have not so far to go will draw their feed down in winter as they require it. Near noon on Saturday July 25 as we were nearing the base of Cypress hills in township 9 a great smoke was seen rising from the bench some twelve miles farther south. Fire had escaped from one of the haymakers who was preparing his midday meal, and several settlers lost their mowers, rakes, wagons and other implements besides what hay they had made. What was worse, a great many acres of valuable timber was destroyed in the ravines and a good many square miles of hay land burned over. Some of the Royal Northwest Mounted Police were soon on hand and all the settlers within accessible distance were ordered out to surround the fire. By hard work it was surrounded and confined to the ravines and timber where it burned itself out. The work of haying had only been in operation a few days so not much of the hay was in stack. To the greater altitude of Cypress hills in comparison with the flats to the north must be attributed the good grass on the benches when it is so poor on the lower ground due principally to the difference in humidity or precipitation, the snowfall being much greater at the higher altitude. Through townships 11, 10 and part of 9 the local governments of the two provinces were constructing a road along the fourth meridian. As there are several deep coulées the district engineer was called upon to survey deviations for the purpose of improving the grades. To find a passable road down to Battle creek it was necessary to deviate a mile west of the meridian to where there is a pass or opening

through the hills. Along the line where the ascent is made from the north in township 8, there are several ravines with very steep banks, and from the summit at the middle point of section 24 a descent of 700 feet including several ravines, thick scrub and clumps of timber had to be overcome in reaching Battle creek in section 13. For five miles the meridian climbs up and down through deep ravines mostly timbered with spruce and poplar while the ridges are covered with jackpine. There is considerable timber in those ravines and along Battle creek, and a sawmill has been built on the main creek about a mile west of the meridian to which point a wagon road was being constructed from the north, also a road up a ravine to the bench south of Battle creek used by settlers in reaching the hay ground. Soil in the ravines is a dark loam sometimes sandy but on the benches loam for a few inches and underneath gravel and as we proceeded south, many inbedded boulders. Each of the ravines crossed contained a stream of cold clear water which was a great luxury after the dry plain and alkaline water to the north. A stream near the southeast corner of township 7 originates from two springs, one on the road allowance and the other just east of the road allowance and flows from openings in the solid rock, the water being icy cold and pure as could be found anywhere. The stream flowing from these two springs is sufficient to irrigate quite a garden for a rancher named Forsythe who resides on the southeast quarter of section 1 in the township above named. Great heat prevailed during the last week in July and the first week in August. On both the 1st and 5th of August the heat reached the excessive temperature of 108° F. in the shade. On August 1st a hot wind from the southwest in the afternoon seemed to strike anything that remained green with a blight as though stricken with frost so that any crop which might have been cut for green feed was turned into worthless straw in one day. This applies only to that belt lying west of Maple creek east of Medicine Hat and between the Cypress hills and Many Island lake. On that date the timber and towns were burning along the Crowsnest Pass branch of the Canadian Pacific railway. Perhaps the heated winds originated from those fires as they came from that direction. I was driving from camp to Walsh on that date and found the heat most distressing. The hot winds and their effect on the crops was the general topic of conversation around Walsh that evening but I did not hear any one associate it with the bush fires which were at their worst when the winds were most in evidence. At Walsh I received your telegram instructing me to repost the fourth meridian and restore all the monuments. I ordered posts from Winnipeg by express and not finding the spades I required at Medicine Hat I ordered them by wire from Calgary. The posts arrived from Winnipeg on the evening of August 4 and I returned to camp on the 5th and the following day we began restoring the monuments from the northeast corner of township 5 northward. Owing to the long drought and clayey nature of the soil the ground in many places was of an adamantine hardness and progress was slow until the sand hills north of Many Island lake were reached when this work was rapidly pushed on to completion. Having completed the restoration of the monuments and posted according to the latest directions the line back to the north boundary of township 24 I continued the restoration north to township 27 to where the monuments had been restored a few years ago when the townships adjoining the meridian were subdivided, completing the work and starting back for Medicine Hat for further instructions on August 28. On September 1, I arrived at Medicine Hat and proceeded by train to Walsh finding there instructions requiring me to discharge my party and proceeded with certain correction surveys. I discharged three men retaining three in addition to my assistant until I completed two of the correction surveys which I could most conveniently reach by using my horses and outfit. I therefore left Medicine Hat on the morning of the 3rd, and reached Many Island lake the nearest camping place to where my first correction survey was located, namely the north boundary of township 14, range 30, west of the third meridian, where on September 5, I proceeded to investigate and make the cor-

rections. On Monday morning, September 7, we started for Bigstick lake reaching that locality on the evening of the 8th. The country around this lake in range 24 where I was required to examine and make a resurvey of the correction line was found to be in the sand hills and many of the original monuments are buried underneath the drifting sand. After searching for some time to try to locate a point on the meridian bounding range 25 on the east and failing to find any monument I got a rancher to point out this mound, which he informed me was at the southeast corner of section 34, in township 14, range 25. From this mound I ran a mile north and then two miles east but failed to find any indication of a surveyor's post or mound. I then returned to the aforesaid mound and ran east finding a mound at the end of eighty-one chains, and another after going a mile farther. This second mound though in a clump of brush, was in fairly good condition and appeared to have been built much larger than the others I had seen and I had an impression that it was on the outline sought. I therefore took an observation at that point, turned off the necessary angle to run a true meridian and retraced the line south to find a post. After running two and a half miles I found an iron post in mound at the northeast corner of section 12, from which I ascertained that the mound which the rancher pointed out as the southeast corner of section 34 was in reality the monument marking the quarters on the east boundary of section 27. Having located myself with reference to the survey monuments I proceeded to retrace the correction line. The field notes will show that a large portion of Bigstick lake is dry this season, but there was no vegetation or growth of any kind on the bed of the lake showing this to be an exceptional year. In running the correction line across range 24 I restored any monuments I found on the ground and established the other corners between these, except those that fell on the bed of the lake or on some shifting sand hill where a few hours wind would cover them from view. While camped near the lake on Sunday night, September 13, an exceedingly hot day, an electric storm came on in the evening and just at dusk I stood on a hill and counted seven fires started by the lightening, two of which were not far away, and the ranchers in the district turned out and worked all night. We also worked all night burning a guard around our tents. Several of the fires ran into sand hills and went out. Towards dawn it turned cold and the others gradually died down and were surrounded and beaten out by the ranchers. Having completed the work here as far as practicable we started on the 15th for Walsh reaching there the next day when the horses and outfit were delivered to Mr. Nesbitt to winter. The other three men were discharged and provided with transportation to their respective homes, while with my assistant I took the midnight train to Lethbridge where I hired a conveyance and started out to investigate a reported error in the east boundary of section 23, township 10, range 22, west of the fourth meridian, which was found and corrected and an agreement entered into by the parties interested to accept the new monument in lieu of the one destroyed. From there we drove to section 24, township 11, range 22, west of the fourth meridian where another discrepancy had been reported. One post we found to be missing, this we had to re-establish but no such discrepancy existed as had been reported and shown on the sketch by the man who reported it. Completing this work on September 19, I returned to Lethbridge on the 20th and took the train for Medicine Hat Monday morning, where I had unfinished business, and took train to Moosejaw next morning to examine into the condition of monuments in township 12, range 1, west of the third meridian, where intending settlers had been unable to find the monuments. Arriving at Moosejaw on the evening of the 22nd I engaged a conveyance to take us to Johnston lake in the aforesaid township. The weather from that time to the end of the month was stormy and cold with daily flurries of snow or rain, and we found it very uncomfortable not having any stove along and no wood except the smallest kind of shrubbery. After locating the third meridian I retraced eighteen miles of the section lines finding all the mounds but only a few posts and where posts were found they were seldom marked, the square tins with numbers

stamped on when the subdivision was made having disappeared so that it was very difficult to find the location of the sections. There were some land seekers out at the time and I directed them to section 20 along which we were retracing the lines. After a few settlers are located they can direct the new comers, or as is usual some expert in the locality after finding the position of a few points can find the other sections by retracing the lines with a compass. A great many land seekers were on the trail from Moosejaw when we were in that district, usually bound for points near Wood mountain and west where good lands had recently been surveyed. They were rushing to get ahead of others and get their land in advance of a railway which is expected to run through there at an early date. There were many land seekers travelling out via the Canadian Pacific railway now under construction northwest from Moosejaw. The lands office at Moosejaw was certainly a busy place during September and October, also at Lethbridge lands office. I would have had to take my place in the line with some two hundred applicants ahead of me if I had sought admission to record a claim or to enquire about land for the purpose of acquiring it. This was a short period after the lands which had been held as railway lands were thrown open for settlement. Having reported on the condition of the monuments found in township 12, range 1, west of the third meridian, I proceeded to Bladworth to traverse a lake reported in township 28, range 1, west of the third meridian, called by the settlers 'Silver lake.' Thence we went to Saskatoon and took the Grand Trunk Pacific railway at Earl for Neola, to investigate a reported error in the marking of a post in township 35, range 13, west of the third meridian. The necessary surveys were made to determine the true position of the post and the marking corrected. We then returned to Saskatoon and took the Canadian Northern railway for Prince Albert. There I hired a team and democrat to drive out to township 50, range 6, west of the third meridian where I was instructed to survey the outlines of fractional section 26 which joins the Sandy Lake Indian reserve. I ran the east and north boundaries of the section, the south boundary having been laid out years ago. Returning to Prince Albert I drove north through the woods to the correction line on the north boundary of township 50 in range 26 west of the second meridian to complete the survey of two lakes which had been traversed in township 51 but not in township 50. The road was terribly rough and not fit to drive over with any kind of conveyance except a strong wagon or cart. I managed to get through with no greater damage than breaking a few bolts and braces. Having finished this work and returned south I purposed surveying some islands in Redberry lake, and went to Borden, the nearest station on the Canadian Northern railway. On October 20, it rained and snowed all day and the storm continued the day following with high winds added to the other storm with no promise of early improvement, so I decided to go east and do some work less precarious until calm weather should return. I took the train to Howell station and procuring a livery rig drove out to township 41, range 27, west of the second meridian, to traverse a lake called by the settlers in the township 'lac Lizar.' While engaged on this work I was taken very ill which prevented me from going on to Basin lake as I had intended while in that part of the country. Changing from house to camp and vice versa after the weather becomes cold is very trying to one's health, and I felt it would be taking a great risk to continue so after I finished the traverse of lac Lizar on October 27. I returned to Saskatoon on the 28th, and on the 29th took the train to Duval where I stopped over to correct the position of a post on the north boundary of section 23 and to traverse a lake in section 9, township 25, range 22, west of the second meridian. From there I went to Lipton and procured a conveyance to take me to township 25, range 13, west of the second meridian to make a correction survey for which the land owners and settlers had petitioned the Department. For this work I hired two men to assist in clearing away the brush and digging the pits, completing the work on November 5, and on the 6th I started for home, reaching Niagara Falls on the 9th.

If I had felt equal to the task I would gladly have remained in the West long enough to finish the work laid out in my instructions, but I did not deem it safe to remain longer.

I have the honour to be, sir,
Your obedient servant,

THOS. FAWCETT, D.T.S.

APPENDIX No. 23.

REPORT OF L. E. FONTAINE, D. L. S.

INSPECTION OF CONTRACT SURVEYS IN NORTHERN ALBERTA.

LEVIS, QUE., February 15, 1909.

E. DEVILLE, Esq., LL.D.,
Surveyor General,
Ottawa.

SIR,—I have the honour to submit the following general report of the season's operations being the inspection of survey contracts Nos. 2, 16, 24, 29 and 31 of 1907, and Nos. 7 and 18 of 1908, all located in the Edmonton district, Alberta, made in accordance with your instructions of April 3, June 18, June 25 and July 9, 1909.

The usual preliminary preparations were made, after which I left for Calgary where I had to remain a few days, in order to attend to the forwarding by rail to Edmonton of horses, transport outfit and camp equipage left at De Winton at the close of the previous season's operations. On May 2, I arrived in Edmonton where I was to fully organize and equip the party for the coming season. This was attended to and everything put in readiness, but, owing to the wet weather, I had to postpone my departure till a few days later. As soon as more favourable conditions prevailed, I left for contract No. 29, proceeding first to Wetaskiwin thence via Falun and Battle lake to the end of the projected trail to Buck lake, now opened as far as the centre of township 46, range 3, west of the fifth meridian, and from here to my destination I resorted to and used pack horses.

During the time devoted to the inspection of this contract I may say that a very unfavourable state of things prevailed. We had more or less rain on twenty-eight days out of a total of forty-two; this proportion I believe would be found excessive if compared with the records of past seasons.

Furthermore, Modeste creek, which seems to be an insignificant little stream, was converted into a regular torrent; it flooded three different times, overflowed its banks and its rushing waters carried off most of the dams located on its course, which were used under ordinary conditions to regulate the flow of water for the driving of logs to Saskatchewan river. This was a serious drawback, for, in order to successfully carry on the operations, the creek had to be crossed at several places and this could not be done at high water notwithstanding repeated attempts to do so. At each attempt, the raft used for this purpose was hurled amongst the trees and brush on the opposite bank and no safe landing could be effected. These conditions greatly hampered operations, and I was forced to make a longer sojourn in this section than would have been necessary had conditions been normal, nevertheless with both patience and perseverance, the object in view was finally achieved. From there I left for Edmonton, arriving a few days ahead of the party and in the meantime giving my attention to the necessary organization for the projected inspection of contracts Nos. 2, 24, 16 and 31.

On July 17 I left Edmonton and proceeded with wagons by way of St. Ann to Chip lake. The trail followed is good as far as St. Ann and fair from there to the crossing of Pembina river. On the west side of the river it is a new trail opened by the Grand Trunk Pacific railway contractors so as to connect the numerous camps along the right of way and though it is not very good it is constantly being improved

and ought soon to be in fair condition. From Chip lake the means of transport was by pack horse and the trail followed was the Jasper trail to 'Big eddy' on McLeod river where contract No. 31 is located.

The examination of this contract was proceeded with and the whole successfully accomplished in less than a fortnight.

My next operation consisted in the inspection of the remainder of contract No. 24.

In order to achieve this object I left 'Big eddy' on August 24, following Jacques trail easterly to the southeast quarter of section 15, township 54, range 16. At this point McLeod river was forded and the journey was continued by way of the Grand Trunk Pacific pack trail as far east as section 30, township 53, range 13.

The necessary inspection operations were carried on through several of the townships comprising this contract and progress recorded to the prevailing conditions.

In accordance with your instructions I then gave my attention to that part of contract No. 7, of 1908, situated on the east side of McLeod river. In order to reach this location I followed an old pack trail running parallel to the valley of Carrot creek and joining the Jasper trail in the vicinity of the fourteenth base line in range 13, and proceeded west from there by the Jasper trail to township 52, range 16.

The examination of this part of contract No. 7, of 1908, was duly made, and next in order was the re-inspection of part of contract No. 24, and the whole of No. 2, of 1907.

To reach these townships I journeyed eastward by the Jasper trail as far as Little Lobstick river and from there to Foley, Welch and Stuart's construction camp at the east end of Chip lake, I went by the Grand Trunk Pacific tote road; from the construction camp I followed the railway right of way a distance of about one and one-half miles and then travelled northerly by various settlers' trails till I reached Jacques trail on section 36, township 54, range 10.

A thorough re-inspection as called for by your instructions was made, and, when completed, attention was given to parts of contracts No. 16, of 1907, and No. 18, of 1908.

So as to successfully visit the greater number of townships embodied in these two contracts I went easterly by Jacques trail from section 36, township 54, range 10 to the meridian line on the east boundary of section 27 township 54 range 9, thence I went northerly following a pack trail opened by the subdivider and which led to the centre of township 56 range 9, and from here on proceeded as much as possible by the meridian lines to Green Court postoffice in township 58 of the above mentioned range on the trail leading from St. Ann to the mouth of McLeod river and thence northwesterly by this road to the McLeod flats. From this point I had no alternative but to double for a certain distance the route previously travelled; I therefore proceeded southeasterly by the McLeod trail as far as Selleck's in township 59, range 10 and from there south to township 56 of the same range, thence westerly across part of ranges 10 and 11 and north to the southeast corner of section 23 township 57 range 11 where I joined a wagon trail leading to Green Court and recently opened by Mr. G. P. Roy, D. L. S., who was then engaged in township subdivision in the vicinity; thence following the said trail easterly I proceeded to township 57, range 10.

Having been informed by Mr. Roy that this township was then ready for inspection, and although not included in my instructions for the present season, as I was on the premises, I thought I should not let pass such a favourable opportunity, and accordingly I carried on the required operations and on their conclusion continued my journey to Green Court.

On my arrival at this point owing to the unfavourable climatic conditions then prevailing and my transport outfit not being adequate to undertake extended travelling I decided that after performing the following miscellaneous surveys I would cease operations.

1. The retracement of the two interior chords of township 57 range 7 west of the fifth meridian together with the traverse of Pembina river in section 1 of the same township.

2. The verification of the monuments at the northeast corner of section 32 and at the quarter section corner on the east boundary of section 10 both in township 56.

3. The traverse of Little island and Windy lakes in township 55, range 5.

On the completion of these operations I proceeded to Lake St. Ann settlement and from there to Edmonton where I arrived on December 20.

The following day the party was disbanded and the outfit stored as instructed.

Concluding, I must record my appreciation of the services of my assistant Mr. C. B. Allison; at all times he has performed his share of work with ability and good will.

GENERAL DESCRIPTION.

The necessary field notes and detailed reports on the inspection of these several contracts have already been submitted, therefore, I will here add but a few brief notes respecting the main topographical features and general resources of the area covered during last season:—

CONTRACT NO. 29 OF 1907.

In this contract an examination was made of township 47, range 4, and townships 48 and 49, range 5.

The surface of township 47 is generally so rolling and thickly wooded throughout, that at the present time it offers very little inducement to settlers.

In townships 48 and 49 the country has a gently rolling aspect and for the most part has been overrun by fire. In such places it is dotted here and there with open prairie spots and islets of second growth poplar. The soil in general consists of a layer of black loam of variable depth resting on a clay subsoil. This section is well watered throughout; besides Modeste creek there are numerous smaller streams having a permanent flow.

No extensive hay meadows were noted, but there is an abundance of good fodder, especially on the flats of Modeste creek where peavine, blue-joint and other luxuriant grasses for stock raising are to be found. These two townships, I believe, would be well adapted for mixed farming.

CONTRACT NO. 31 OF 1907.

The general aspect of the surface of the six townships comprising this contract is slightly rolling. It is a succession of low ridges running parallel to the general direction of McLeod river. The devastating fires have not spared this section; part of it has been burnt, but what has escaped the fires is well timbered. In township 52, range 19, and adjoining McLeod river a good block of timber suitable for lumber was noted.

McLeod river meanders through townships 52, ranges 18, 19 and 20, and township 53, range 18. Its general direction in this vicinity is east, its width is on an average two hundred and seventy-five feet, with a current of two and one-half miles per hour. It flows in a valley having an average depth of one hundred feet, the banks sloping from two to thirty-five degrees. Its sinuous course forms intermittent flats of more or less extent and several of these have already found occupants. Except on the river flats the nature of the soil in general is sandy, but a good many sections suitable for mixed farming are scattered throughout this locality and owing to the proximity to proposed railways, intending settlers have already made entries.

The Grand Trunk Pacific railway company survey lines were intersected in townships 53, ranges 18, 19 and 20.

Numerous hay sloughs of variable acreage are to be found interspersed among the surrounding ridges, and the hay crop gathered therefrom would be more than sufficient to supply double the present demand.

Traces of drift coal were noted at several places along the course of the McLeod but nowhere could any coal seams be located.

A store where one can procure all the necessaries of life and a good many luxuries is located in section 3, township 53, range 18.

In McLeod river and its tributaries delicious brook trout, whitefish and pickerel can be had during the open season. Game, with the exception of bear, is scarce.

PART OF CONTRACTS NO. 24 OF 1907 AND NO. 7 OF 1908.

Owing to these contracts being contiguous, the main topographical features of the various townships allotted in each being almost identical, and to avoid repetition, the following general description will apply to both.

The surface of this section is rolling. It is a series of jackpine or poplar ridges with intervening depressions, wherein muskegs and swamps of more or less extent are to be found. Most of these swamps can be easily drained and by so doing the present available acreage for settlement in this vicinity increased, but I believe that the alternating flats along the course of the McLeod together with the good arable lands bordering Carrot creek and Wolf river will be found sufficient to meet the increasing demand for some time to come.

The soil in general consists of a light loam resting on a clay subsoil, and except for the valley of the rivers above mentioned, where it is of a better quality, the remainder may be called third class.

Fire has overrun this section in many places destroying the merchantable timber along the water courses. The parts thus visited are now covered with heavy windfall intermingled with a second growth of poplar, and owing to these conditions are next to impassable for man or beast.

The course of McLeod river, flowing in a north-northeasterly direction, crosses ranges 15, 16 and 17. The stream has an average width of three hundred feet and a current of two and one-half miles per hour. The valley is one hundred and twenty-five feet deep and the slopes to the river vary from two degrees to an abrupt cut bank.

The right of way of the Grand Trunk Pacific railway is intersected on the east boundary of sections 15 and 16, township 54, range 14, and also on the east boundary of section 3, township 54, range 16. On the east boundary of section 4, township 54, range 16, survey location lines in connection with the same railway were also noted.

The Grand Trunk Pacific railway tote road from Chip lake to the McLeod crosses the east boundary of section 29 and the north boundary of section 32, both in township 53, range 13.

RE-INSPECTION OF PART OF CONTRACT NO. 24 AND ALL OF NO. 2, BOTH OF 1907.

Owing to the special instructions regarding this particular section and presuming that a description of the territory has already been supplied when it was previously visited, I will not duplicate here the information already given.

PART OF CONTRACT NO. 16 OF 1907.

In this section the topography is of a varied nature; in township 57, range 9, township 58, and the south half of township 59, range 10, the surface is rolling, but the remainder of this locality, with the exception of the flats bordering the Athabaska, is broken and hilly.

A range of hills, varying in height from one hundred and seventy-five to six hundred feet, and distant a mile from the shore line, follows almost the course of the Athabaska and McLeod rivers, and enchasms an extensive flat known throughout this district as the 'McLeod flats.'

The soil of this flat is exceptionally good, and as proof of its excellency I may add that several settlers had already located previous to the survey.

This section has been visited by fire, but here and there islets of poplar and spruce have been spared, while the remaining surface is covered with a second growth of poplar.

Athabaska river, which is one of the large streams of northern Alberta, flows easterly at a rate of five miles per hour, and winds in and out of townships 59, in ranges 10 and 12. It has an average width of eight hundred feet, and in many places its waters are diverted into a number of channels, thereby forming numerous islands and gravel bars.

McLeod river empties into the Athabaska on section 35, township 59, range 12. Its width here is five hundred feet and the surrounding hills are one hundred and seventy-five feet in altitude.

A coal seam twenty-five feet thick, one hundred feet long and ten feet above the water's edge in the bank of Athabaska river, one chain west of the east boundary of section 33, township 59, range 10, was noted.

PART OF CONTRACT NO. 18 OF 1908.

The general aspect of most of the townships in this locality is rolling, with partly open spots alternating with clumps of poplar.

The soil in general consists of a layer of black loam with a clay subsoil, and for the most part may be rated second class.

This section is well watered. Besides Paddle river which winds in township 56 across ranges 9, 10 and 11, there are numerous small streams with an abundant flow.

Owing to the good arable lands and its close proximity to the Grand Trunk Pacific this section will no doubt be rapidly taken up by land seekers, for all indications tend to show that it is a favourable spot for mixed farming.

TOWNSHIP 57, RANGE 10.

The surface of this township is rolling and covered for the most part with poplar and willow scrub.

A few islets of green timber suitable for building purposes have been spared, but the supply therefrom for such purposes will be limited.

In this township a permanent supply of good water is to be had. This coupled with the abundant fodder and the excellence of its soil in certain sections would make these particular spots most suitable for mixed farming.

I have the honour to be, sir,
Your obedient servant,

L. E. FONTAINE, D.L.S.

APPENDIX No. 24.

REPORT OF T. D. GREEN, D.L.S.

SURVEY OF COAL LANDS IN WESTERN ALBERTA.

PRESCOTT, ONT., March 15, 1909.

E. DEVILLE, ESQ., LL.D.,
Surveyor General,
Ottawa.

SIR,—I have the honour to submit the following report of my work during the season of 1908.

On June 15, I received your telegram to report to you for duty, and reached Ottawa on the 18th. My instructions dated June 15 were, in short, as follows:—To subdivide as far as practicable townships 40, 41 and 42, range 19, and township 42, range 20, west of the fifth meridian, for the particular purpose of locating certain coal lands.

On the 22nd I took the train for Edmonton, Alberta, where I arrived on Saturday, the 27th. On the following Monday I sent to Angus McDonnell, near the village of Ray, for the horses and outfit allotted to me. On enquiry about the route to the Brazeau district, I learned that the only practical summer route was from Banff or Laggan on the main line of the Canadian Pacific railway, and as it was necessary to hire a whole car to transport the horses from Edmonton to Laggan I concluded, that in order to save time and to be sure of securing trained pack ponies, to complete my transport and camp outfit in Edmonton and ship all to Laggan. This I did with as little delay as possible and reached Laggan on the afternoon of July 6th. Fortunately, Thomas Wilson, of Kootenay plains, on Saskatchewan river, arrived in Laggan on the 8th, having come over the route we were taking and gave us full information of the trail and fords, but advised us to wait two days, when he would return with us and show us the proper fords and trail, as the rivers were flooded and there was still considerable snow on the Pipestone summit. However, as our horses were soft, our packs heavy, and the feed around Laggan very poor, we decided to make a start and go by easy stages until Mr. Wilson overtook us. We reached the Kootenay plains on the 17th and crossed Saskatchewan river on the 18th by swimming the horses, and conveying the goods across the river in Mr. Wilson's canoe. All these streams were high and flooded, and being very rapid, were dangerous to those unacquainted with the exact location of the fords, especially those of Siffleur and White Goat rivers.

We reached Bighorn river on July 20, and Brazeau river near the northeast corner of section 36, township 44, range 19, west of the fifth meridian, on the 27th.

On the 29th I started a meridian line from the said section corner and ran south on the outline between ranges 18 and 19 and completed it to the southeast corner of section 1, township 43, of said range, on August 14.

The country in the immediate vicinity of the foregoing line is rough, hilly and mountainous, interspersed with numerous muskegs and brooks along which latter one is compelled to travel, although frequently driven to the tops of the high banks on account of the gorges and muskegs. The timber is generally small spruce, balsam and poplar.

On August 17 we again reached Brazeau river, about a mile south of the northeast corner of section 36, township 44, range 20. A canvas canoe allotted to me having

been appropriated by another surveyor, I was left without one, and now, owing to the recent heavy rains, I found Brazeau river a torrent. We immediately began to build a raft and having completed it began to transport the party across the river, but found the raft too heavy and unmanageable in the very swift current, and after several narrow escapes from accidents, we were compelled to abandon it and to build another.

On August 25, we began the meridian outline between ranges 19 and 20 of the said township and completed it to the southeast corner of section 1, township 43, on September 12. We did not run the 'jog' at the end of this line because we were short of provisions. This meridian line crosses the northwest extremity of the Bighorn mountains, and the country in the immediate vicinity is rough and mountainous, with numerous muskegs and small streams of good water. There are no trails and one is compelled to cut out pack trails to move the outfit. There is some good timber along Brazeau river.

The general description of the country along and between the two lines is broken, hilly and mountainous, thickly covered with small spruce, balsam and poplar, interspersed with numerous muskegs and streams of good water. The grass is luxuriant in places but is not generally abundant. Fire has devastated the whole country and one frequently encounters vast sections of windfall and brulé. It seems a pity that some means can not be devised for removing the dead and fallen timber as, should another fire start, this fallen timber will be excellent kindling to ensure its spreading.

We were told that there was an old trail going southeast from near the south end of our last line by which we could quickly reach the south branch of Brazeau river, but we could not find it and were compelled to return by the same route by which we entered.

On Monday, September 14, while journeying southward towards the eleventh base line, the main camp met Messrs. Round and Anderson returning from Laggan with a supply of provisions. As nothing had been seen or heard of D. L. S. Saunders, and his operations on the said eleventh base line, and as we were conveniently near the 'jog' on the eleventh correction line between ranges 18 and 19, I decided to run said 'jog' which we completed on the 18th. We moved to the south branch of Brazeau river on the 19th, and camped in the immediate vicinity of the coal lands located on said stream. Learning that the eleventh base line was not yet sufficiently run westward for me to use, I made a traverse survey of the location posts of the coal lands here and completed the same on the 24th. This traverse would have to be made some time, and as it was convenient to do it now, we did it so as to allow us more time for the subdivision work when we came north with our work from the eleventh base line. On the 25th we moved camp southward on the Brazeau trail to a point near 'The Grave,' near which point we estimated the base line would cross.

We spent the next three days trying to locate D. L. S. Saunders, who was surveying the base line, but could not find any signs of his party or of their operations. After satisfying myself that the base line had not been surveyed westward over and across the bald and rugged range of the Bighorn mountains, I decided on account of the lateness of the season that it was not advisable for me to wait any longer. I learned afterwards that the survey of the said base line did not reach range 19 (where I was to begin operations) until the end of November, which means that it would have been necessary for me to wait more than two months before doing any more work. On September 29, after having left notices of my action for Mr. Saunders, I abandoned further operations and started southward for Morley, where I stored my camp equipage and arranged for the wintering of the horses in accordance with a previous communication to you.

I have the honour to be, sir,
Your obedient servant,

T. D. GREEN, D.L.S.

APPENDIX NO. 25.

REPORT OF A. H. HAWKINS, D.L.S.

SURVEYS OF PARTS OF THE TWELFTH AND THIRTEENTH BASE LINES WEST OF THE FIFTH MERIDIAN.

LISTOWEL, January 14, 1909.

E. DEVILLE, ESQ., LL.D.,
Surveyor General,
Ottawa.

SIR,—I have the honour to submit the following general report of my field operations under instructions from your Department for the production of the thirteenth base line from range 17 to the sixth meridian, and the twelfth base line from the fifth meridian, west to range 20.

I left home for Edmonton May 9, 1907, reaching my destination on the 14th, and upon enquiry found that I was too early to attempt to take the field with a pack train as the season was very backward, and consequently the grass upon which we had to depend for horse feed had not sufficient growth. I did not, therefore, leave Edmonton until June 7, taking the larger portion of the outfit in wagons, in order to have the pack train in as good condition as possible when called upon. The wagons were paid off at the west end of Island lake, as the roads were in very bad condition, practically impassable any farther. We reached the Pembina crossing on June 17, and found the river very high, so that we had early use for the King canvas boat supplied by the department. We followed the Yellowhead Pass trail from this point, finding it very bad indeed; in many places being merely a streak of mud through the forest rather than a horse trail, and constant showers did not improve its condition. Progress was accordingly very slow, as we were forced to relay over the worst portions, and unpacking an pulling horses from mud-holes was an hourly occurrence.

On June 26, somewhere about range 14, west of the fifth meridian, according to information I had received, we found a trail which was said to lead to the southwest, and probably near the thirteenth base line. Here we nailed up a mail box on the main trail, left our letters and started into the country west of Lobstick river, off the trail, which was practically unknown. Some packers who had been over the trail, pretended to give information, but it was always couched in such general and ambiguous terms, that the writer found many interpretations might be put upon it.

The trail which we were following, however, led to two large creeks, evidently tributaries of the Pembina, and at that time full to the top banks with recent rains.

We were by this time ten or twelve miles south of the base line, but our trail was heading to the southeast, instead of the southwest, as I had been informed, so that upon crossing these large creeks, I determined to cut our own trail, and travel in the direction we wished to go.

On July 4, I sent my packer back to get supplies from 'Big eddy,' the location of which we did not know, except that it was on the Jasper trail and to the west; and with the balance of the party, I kept pushing my way towards the base line. Two men were sent to explore for the line from the large creeks, and found we were opposite range 14, and they estimated that we were fourteen or fifteen miles to the north, and that the intervening country was a horrible muskeg; however we pushed along as fast as possible, as now we had to not only cut trail, but find a place

where a trail could be cut, as the continued heavy rain was converting the country into a vast bog, and the daily rains did not add anything to the comfort of life. Our packer returned with provisions on July 23, but had been forced to leave a horse en route. With this supply I hoped to reach the starting point on our line, and possibly find some better country through which to run a trail to the north, as my packer informed me that it would be impossible to bring in supplies over this trail again. By the time we had reached section 32, township 48, range 17 west of the fifth meridian the efficiency of my pack train was alarmingly reduced, as our supplies were low, three of our horses had died from hoof rot, which seemed to be caused by the constant travelling through mud, several others were afflicted and could take no loads, and to add to our troubles the feed was very scanty and poor. I had explored the country ahead as far as possible, but there seemed to be no change in its character; apparently it was not a country for trails. I had therefore to make a start at once for the Jasper trail, as only some five days provisions remained, and after cutting horse trail for two days, and penetrating some seven or eight miles north, we found it impossible to take the pack train further. I therefore gave orders to abandon everything but axes, a canvas pack cover, and the balance of our provisions, and strike for 'Big eddy' or the trail. We reached 'Big eddy' on August 12, and here we had at least provisions, but unfortunately the packer who was to move our supplies had started a few days before for the mountains, and I had to await his return to move my outfit. However, as we did not know anything of the trails, or if there were any leading to the south from 'Big eddy.' I questioned all comers who were likely to know, and ascertained that there was supposed to be a trail on the east side of Embarras river said to lead to the south. I therefore cut a trail on the south side of McLeod river at 'Big eddy,' and pushed it southward until we met the trail leading up the Embarras; by the time that this was completed the packers had returned, and were ready to move our provisions. Although I had been assured the packers knew the country, they both were certain they knew nothing about it, and could not speak English. Just here I should like to warn surveyors, who have not had the experience, that half-breeds and Indians will almost invariably claim to be unable to speak English, although knowing it fairly well, thus frequently giving a surveyor much trouble. This same packer, a half-breed, came to me on my return this fall, addressed me in excellent English, asking how I got along, &c.; the lesson is obvious. However I was not to be put off, as my outfit was on the thirteenth base line, and myself and party on the fourteenth. After four days travelling, a portion of which was over a very good trail, he found English enough to inform me, he thought we were twenty-four miles south, but I insisted upon another day's travel, before accepting the delivery of the goods, and on August 30, I took over the supplies, and we were again on our own resources, but as I had no instrument with which to ascertain the latitude, we could only guess as to our position. Next day, however, we started in to find our abandoned camp and horses, and after five or six hours of travelling through muskegs we came across the trail which had been made in going to 'Big eddy' some two weeks before; and reached the camp in the afternoon.

The following day one man returned for the balance of the party whom I had left camped at the cache, which, by the way, was still some four or five miles north of the base line; the rest of us started in to round up our pack ponies, and soon had them together, with the exception of two, one of which had died, but the other had strayed off and could not be found.

We succeeded in getting a fairly good pack trail from the cache to the end of our line, and on September 5 had pushed ahead so that we were then able to start cutting on our line, having occupied almost three months in getting to the work and making a trail over which we could get in sufficient supplies. Everybody was much relieved and we hoped with what supplies we had to reach our cache on McLeod river. But just then, through a violent snow storm, we lost four days, which made us decidedly

uncomfortable, as four to six inches of wet snow is, in the woods, probably the most disagreeable experience one can have. However, as soon as the snow ceased falling our line was continued with few interruptions about twenty miles to range 21. The three men whom I had sent out a week previous to find McLeod river and locate our cache returned, with the information that they had found the river and had followed it for twenty miles north without finding the cache. There appeared nothing to do but to follow this river, as I knew it would lead to 'Big eddy,' whether it were the McLeod or a branch of the Embarras, and by this time my supplies were getting very near the vanishing point. We had, therefore, to leave our line again and reached 'Big eddy' on October 14, just one week from the line, and having to cut trail most of the way.

The country over ranges 18, 19, 20 and 21, so far as I could ascertain, is a series of low jackpine ridges, generally covered with heavy windfall, and largely composed of a clay and quicksand soil, so that after three or four horses had passed over it became an impassible mud-hole, necessitating a new trail. Between these ridges were muskegs, generally supporting a stunted growth of spruce and tamarack, through which we had to corduroy the worst portions to make our trail passable. I had expected that on reaching any streams the water would naturally draw off and leave us on more solid ground, but except a very narrow strip along the banks muskeg prevailed everywhere. Small meadows were found along the east and west forks of the easterly branch of Embarras river, but in the vicinity of the base line these were of small extent, although farther to the north there are some very excellent meadows producing a good quality of grass. One in particular about four or five miles south of the mouth of the Embarras was observed; it would be from three to four miles in length and a mile wide. About the centre of this meadow the Embarras divides into two large streams, and in the vicinity of this fork the land appears to be fairly good on both sides of the river, and would be well adapted for a horse or cattle range, but so far as I could ascertain the extent is not large, and probably would be all included in two or three thousand acres.

In range 20, we came upon a large tract of open country evidently recently burnt over, supporting in places an excellent growth of grass in the valleys, the ridges however being chiefly covered with a thick growth of small jackpine and willow. Many traces of deer and moose were noticed in this locality, and I have no doubt when access is practicable, it will make an excellent grazing range. The whole of range 20, probably two to four miles north of the base line, and four to six south of it would take in this open area.

At 'Big eddy,' I was fortunate in finding some supplies that had been ordered when last here, and after arranging our affairs, we left for our cache on the McLeod, which we reached on October 19. As I had my instruments along on this occasion, I ascertained the latitude of the cache to be 53° 23′, or some twelve miles too far north. Evidently the freighter had ignored the positive instructions given by Mr. Saint Cyr to place the goods six miles south of the junction of the west fork and McLeod river, and had placed them six miles north, which to us was a very serious matter, as this portion of the trail is very rough and little travelled, and from the base line meant a trip of from three to five days, depending upon the condition of the river, as the trail crosses it some eighteen or twenty times in this distance.

After renewing our supplies from the cache, which was only in fair condition, we continued our journey to a camp ground on 'Big prairie,' where I ascertained the latitude to be 53° 11′. Here I left my camp while I explored ahead for a trail to reach our line, about fifteen or eighteen miles eastward. Fortunately at this point the McLeod takes a sharp bend to the east, and I followed the river trail about twelve miles farther up the stream, and climbed the high hills on the north side. As these are wholly or partially denuded of timber I was able to recognize the hills where our line had been abandoned, and could distinguish the cache that had been placed on the

hillside and covered with a white tarpaulin. It required three days to locate and open a trail to a camp in the Embarras valley, from which we could reach the end of our line, and on October 29, we began to produce the line westward. This was continued until November 18, at which time we had reached the west boundary of range 23 and winter was apparently on.

The country through range 21 is a series of high rolling hills, evidently the advance guard of the mountains, cut by the west fork of Embarras river, which is crossed by the base line within a few miles of its source. A rather fair piece of country though small in extent was crossed in this basin of the Embarras on the west side of range 21, but it does not exceed one thousand acres. From the west side of the Embarras valley to the McLeod, the line passes through some very fair spruce timber, with a scattered growth of jackpine; trees eighteen to twenty-four inches in diameter were frequently met with, but the country is cut by many muskegs, in which are formed small creeks running into McLeod river.

I had ordered no oats, as so many vexations and tedious delays had not been anticipated. The grass had been frozen and killed for over a month, and for working horses without oats, was very poor food, so that on November 19, I started on my return trip to Edmonton, and as we had to relay, the party did not reach that place until December 20; the writer, however, arrived some days earlier and found your instructions to proceed with the twelfth base line, to begin at the fifth meridian. After a few days spent in arranging for further supplies, and some rearrangements in the party, I left for Lacombe and Ponoka on December 28, left Ponoka with the party on January 1, 1908, and on January 4, began retracing this line. In contrast to our experience on the thirteenth base, we never lost a day until heavy snowstorms in April kept us back slightly. The three first ranges of the twelfth base were almost without obstacles in the matter of trails, as settlers' roads could be used as far west as the Buck lake trail in range 3. After this, so far as the trails were concerned, we were on our own resources again, but my packer was an exceptionally good man, and with the additional assistance allowed by the Department, I found it necessary only on two or three occasions to put the full force to cutting trail, so that our line was steadily pushed forward until we reached range 17.

The retracement of the base line ended at the east boundary of range 9, where in accordance with your instructions, correction was made for the amount of accumulated error, across the eight ranges retraced, in section 31 of range 8. Some difficulty attended the crossing of the Saskatchewan valley, as the banks are steep and precipitous in this locality, but once on the western bank, the surface is gently rolling, and largely muskeg with low ridges covered with small jackpine and windfall, which condition prevailed until we reached Little Brazeau river.

Some very fair timber was noticed between the Saskatchewan and Little Brazeau along sections 33, 32 and 31, range 9, and apparently extended some distance south.

The land along the Saskatchewan is very rough and broken, the bottom lands being covered with a heavy growth of spruce timber, while along the banks a large amount of dry timber and windfall is to be seen.

Along the Little Brazeau were noticed several fine meadows, one lying just north of the line, about eighty or one hundred acres in extent, to which could be added sufficient to make a very good range by cutting the brush on the upland, as the soil is apparently fertile, and in this locality extended from three-quarters to one mile on either side of the river, but in many places the muskeg extends right to the high water mark.

Between the Little Brazeau and Brazeau proper, the country is largely muskeg, and low ridges covered usually with jackpine although a few poplar bluffs were noticed, but they were usually small. Dry timber and windfall prevailed all along, and on the Brazeau was very thick, which rendered trail cutting difficult, but once on the

main Brazeau, which we struck in section 36, township 44, range 13, the question of trail was solved for, so long as we used sleighs we kept our trail on the river, and were thus able to push rapidly ahead.

The river bottom affords considerable feed, in the shape of goose grass, but the larger meadows, of which several were noticed, were so badly littered with windfall, as to make them almost useless, without clearing. In section 32, township 44, range 15, the line again crosses the river, and several rather open meadows were noticed, which would probably produce good grass in the late summer and fall, but numerous indications of inundation were observed all along, which would rather deteriorate from their value. The land between these crossings is very rough and rolling, cut by many ravines and creeks, leading to the river, and is largely covered by windfall and dry timber.

Some drift coal was noticed along the valley, but no coal in place was observed.

On March 27, my packer informed me that it was necessary to move our camp and outfit as far as possible up the river next day, and for him to leave with the teams at once, as otherwise they would not get out, as the river was beginning to break very fast. We therefore moved to section 35, township 44, range 16, about six miles ahead of the line, and from this position we produced the line into range 17.

From section 35, range 16 to section 34, range 17 rather a fair tract of country was crossed, extending to the river, and south to the foothills, which could be cleared and cultivated with little trouble.

Upon completion of the line to range 17, we lost four days, as my pack train had not yet arrived, and the line had been produced about six miles beyond camp; fortunately, however, two prospectors with a band of pack ponies came along just at this time, and I thought it better to engage these men to move us ahead, than to wait for our own horses. Arrangements to this end were made but as their horses were small, not very well fed, and numbered but eleven, the camp and stores had to be moved in relays; however by careful arrangement we were able to keep the line moving.

Ranges 17, 18 and 19 lie in the foothills, which are rather rugged, cut by many deep ravines leading to the Brazeau, and covered with burnt timber, much of which was standing, and a second growth of jackpine and willow. The line passed through a nice bunch of pine and spruce timber, from the crossing of the Brazeau in section 35 to section 32, range 19, extending from one-quarter to three-quarters of a mile north, and over a mile to the south, apparently across the river and well up the hills on the south side. The country in the foothills, although rugged, would I think, if cleared, form admirable cattle ranges, as many places could be easily improved which would support a good growth of grass, while abundance of good water is always available.

We finished the twelfth base line on May 14, and next day started to cut our trail to McLeod river. The old trail had evidently fallen into disuse, and was very difficult to follow in places, but here our good fortune followed as we met a gentleman looking over the Brazeau coal lands, who had come from the McLeod, under the direction of an efficient guide. As they were very lightly loaded, they travelled through muskegs and over fallen timber which was quite impossible for us to attempt without first clearing the way, but on May 25, we reached an old camp ground on the McLeod, and next day found our cache, that had been sent out during the winter, in the place designated. We were now in a position to successfully attack the thirteenth base again. The line between the main branch of McLeod river and the west fork runs through a rather rough and broken country, not at all adapted for agriculture, although in the valley of the McLeod there are several very excellent hay meadows, one lying to the south of the base line being exceptionally well thought of. With the exception of one or two short breaks, this meadow, locally called the 'Big prairie', extends up the river a distance of ten to twelve miles, and would make a most admirable cattle or horse ranch, as there is ample timber for shelter or buildings, and a large amount of excellent pasture, a considerable portion of which could be readily cut for

hay, and in the most favoured portions I have no doubt potatoes and oats could be successfully raised. After leaving McLeod river, the land is poor and great difficulty was experienced in finding grass for our horses. Things became worse, as we approached the mountains, so much so, that during the latter part of June, and early part of July we had to feed oats, a supply of which I had sent in during the winter to my McLeod river cache.

As we approached the mountains the country became much more rugged, cut by numerous deep ravines, and high rocky hills, chiefly wooded, although many covered with windfall having been burnt over, were in sight. The green timber was chiefly spruce, while that burnt over was pine, the spruce however seemed to have resisted the fires that have apparently swept this country.

The northeast corner of township 48, range 26, falls on the summit of the Folding mountains, and from this point to the centre of range 27, we were in the mountains proper, and in order to produce the line across range 26, we were forced to abandon our horses, and move camp on our backs. Some of the party demurred at this unaccustomed method of transportation, but when the chief showed them how it was done by a practical example, they all followed suit, and in this way we succeeded at last in producing our line to the summit of Fiddle Creek range, one of the most rugged and precipitous in this rugged locality.

Chaining was found to be practically impossible across Drystone and Fiddle creek valleys, and had to be accomplished by following the ridges around from one peak to another. From one of these ridges one could throw a stone into the valley of either the Drystone, Fiddle creek, or McLeod, all of which are timbered with stunted spruce and jackpine, with a large amount of windfall. The summit of Folding range at the time of my visit was covered with several varieties of beautiful wild flowers, forget-me-nots, white heather, and a very fine moss flower, besides several other varieties, which in a measure rewarded one for the rather arduous climb to reach them. This summit appeared to be composed of a disintegrated granite, with large boulders of limestone in many places, while the summit of Fiddle Creek range was limestone, the peaks however being capped with sandstone, chiefly broken up in large cubical chunks or flat slate-like pieces, all very difficult to climb and wearing out shoe leather with alarming rapidity.

After establishing a station on the summit of Fiddle Creek range, we returned to our main camp in the valley of a branch of the west fork of the McLeod, where we had left our horses, and my packer had, with the assistance of some Indians, who fortunately came along, found and opened an old trail north and west to the Jasper trail, striking it some fourteen miles northwest from Fiddle creek, and thus taking us around the impassable Folding and Fiddle Creek ranges. We followed the Jasper trail to where Fiddle creek leaves it, and thence up Fiddle creek trail to a point from which we could reach our station on the summit of the range. From this camp ground it was simply a matter of climbing and working one's way around the bare cliffs. The several branches of Fiddle creek were truly a fearsome sight, as in many places the gorge was cut through solid rock, that towers six or eight hundred feet above the bed, which is composed of boulders of all shapes and sizes, intermixed with logs as though hurled together by some Titanic hand into a most incomprehensible jumble. The climbing was so arduous and so wearing on shoe leather, that none of the party had the courage or ambition to go to the hot springs, said to be on the south or main branch of this creek, as by this time it had become necessary to devise all sorts of means to prolong the life of boots and shoes.

Once over the mountains chaining was again resumed, and the line quickly produced to Athabaska river, and here our canvas boat was again called into use, and as the water was very high and the current strong and treacherous, it was only by the greatest care we succeeded in getting safely across and producing the line to its intersection with the sixth meridian. While here however I had the good fortune to

meet Mr. A. Saint Cyr, D.L.S., who was producing the sixth meridian over the mountains from the north.

The tie line northward to connect with the fourteenth base line was run without much difficulty, as our horses had ample feed in the valley of the Athabaska, and although the timber was thick and hard to clear in places, the worst portion of the line was behind us. Coming from the McLeod valley to the valley of the Athabaska was like getting into a new country. The grass was very fine and luxuriant in the open places, in fact vegetation of all kinds had a more flourishing appearance. The meadows were a mass of orange lilies and roses, and although flies and mosquitoes were more numerous and savage, every one seemed to enjoy the change.

WATER-POWERS.

Water-powers might be developed in many places along both the twelfth and thirteenth base lines by means of dams, as the current is invariably rapid and the banks in many places well adapted for power development. The best places were on the main Brazeau and Fiddle creek. On the main Brazeau through township 44, ranges 17, 18 and 19, the main bed of the river lies through canyons the sides being almost perpendicular in places, and the power that might be developed practically unlimited, as the river is said to have its source in the everlasting snows and glaciers that cap the mountains surrounding its head waters.

Fiddle creek is if anything better adapted for the development of power, although the volume of water is much less than that of the Brazeau, but its course through the mountains is so hemmed in by rocks that in places damming to any height would be comparatively an easy performance, and would have the additional advantage of being close to the main line of the proposed Grand Trunk Pacific railway. This stream is fed by numerous springs, among them being several hot springs on its main branch, some seven or eight miles up stream from the crossing of the thirteenth base line.

TIMBER.

First class timber was very scarce along these two lines although the whole country is classed as timbered, but fire which at various times has swept over the whole country, has destroyed thousands of acres of what apparently has been very fine timber. Many places on both lines were covered with windfall piled at times eight to ten feet above the ground, with trees whose diameter would run from two to three feet, indicating a soil adapted to a good vigourous growth. In townships 48, ranges 20 and 21, where the line passes through an open country, the timber has apparently been burnt off, as logs and standing stumps, thirty to thirty-six inches in diameter were frequently noticed. On the thirteenth a fringe of timber was noticed along the east branch of the Embarras, through range 18 and part of 19, but it appeared to extend a very short distance on either side of the line. Through ranges 22, 23, 24 and 25 more or less timber that was fairly good was passed, trees in places being sixteen to twenty-two inches in diameter, but muskegs seem to spread all over this country and in places extend right to the river banks.

Along the Athabaska and on the west side of it the line ran through the finest timber that was seen, but the area was small, just a fringe along the river.

The line connecting the thirteenth and fourteenth base lines, ran through a very fair bunch of timber bounded approximately by Drystone creek to the south, Jasper trail to the east, and Athabaska river and Brulé lake to the west and north. The timber is chiefly spruce, six to twenty-four inches in diameter, but rather short and very limby. A few specimen of Douglas fir and a few small pine were also noticed. This timber on the Athabaska will be easily logged, as the Athabaska is a river that would probably not be difficult to drive, and three to five miles would be the longest haul required, while Brulé lake is in an admirable position for holding logs. The timber along the McLeod and between the west fork and McLeod river will, I

think, be comparatively easy to put into the water, and the river with small improvements easy to drive.

On the twelfth base line a small amount of good timber was noticed in the valley of Saskatchewan river, and several patches of second class timber before Little Brazeau was reached. From this to the main Brazeau was chiefly muskeg and the timber, except in the valleys, was of little value, and with the exception of a few scattered large trees immediately along the river no timber was seen until we came to range 19, which extends from sections 35 to 32, is rather thick, and would run from six to twenty-four inches in diameter, but the extreme difficulty of driving the Brazeau on account of the rapid current and numerous channels and bars make the value of this timber rather problematic.

As to the future of the country governed by these two lines, there are places where mixed farming might be successfully carried on, with special attention to cattle or horses, once roads are opened and easier and more speedy means of transportation provided.

At the intersection of the twelfth base line with Little Brazeau river, and at the first and second crossings of this base line with the Brazeau, are tracts that could be easily cleared, and would doubtless provide a good living. Along ranges 17, 18 and part of 19 on the twelfth base, the country has been repeatedly and badly burnt, but with cultivation, I am satisfied good hay and probably oats could be raised. If cleared of the windfall, many places in these foothills, ranges 17, 18 and 19 would be ideal ranges for cattle, as also are some of the river flats along the Brazeau.

On the trail leading from the Brazeau to the McLeod a very nice meadow was passed along the north fork of the Brazeau, indicating that good meadows might be found along this river. About the headwaters of the Pembina and McLeod are numerous meadows well watered and yielding abundant grass, and would probably with improvements make excellent ranges, but the elevation would lead one to expect summer frosts, that would prevent farming to any great extent.

On the thirteenth base line there are some excellent meadows along Embarras river, the eastern branch of which is crossed by the line in section 32, range 18. To the south the valley appears to be very narrow and rough, but to the north are several fine tracts of meadow land both on this and the western fork. These two branches meet about eight miles south of the fourteenth base line, and join the McLeod about section 1, township 52, range 19. At the junction of the two branches of the Embarras is a very fine meadow some three miles long and extending from one-half to one and one-half miles on either side, and will doubtless at no very distant date be occupied by some enterprising rancher, as the grass and peavine are excellent, and the supply of water, of course, unlimited, while there is sufficient timber for building and fuel close at hand. In winter this place would be easily reached by following the McLeod from 'Big eddy' to the mouth of the Embarras and thence up that river on the ice. In summer the trail cut by the writer on the south side of the McLeod from 'Big eddy' leads through it.

At the intersection of the thirteenth base line and McLeod river lies another very excellent meadow, known locally as 'Big prairie.' The meadow land extends, with but two small breaks from eight to ten miles up stream, and is in the writer's view an ideal ranch for horses or cattle. The valley is from one-third to three-quarters of a mile wide, and in many places hay could be cut without preliminary clearing. Oats, potatoes, and garden produce could be grown here without trouble, as the country has but a slightly greater elevation than 'Big eddy,' where Messrs. Brethoux and Sinclair have most excellent gardens, with small improvements.

Some few small meadows were noticed on the west fork of the McLeod, but all of small extent; the soil is very gravelly and the grass is short and poor compared with that of the main McLeod.

The valley of the Athabaska was the next point that attracted our attention, and presented possibilities for farming, and, after our sojourn in the mountains and higher

altitudes along the line, was like a different country, although where our line crossed at the head of Mud lake, an overflow of the Athabaska, it did not appear inviting, but both north and south of this point the country is more interesting. To the north along the Jasper trail are many beautiful meadows, supporting a most luxuriant growth of grass and peavine and I am informed horses can winter here and do well. This locality will without doubt at no distant date be one of the beauty spots on the Grand Trunk Pacific railway as the valley is walled by the rugged precipitous bluffs of the Folding and Bullrush mountains, which present most gorgeous colourings, both at sunrise and sunset. It is watered by Drystone and Prairie creeks. The open meadows during the summer are a mass of flowers, and backed by the darker green of the coniferous forest surrounding it, makes a picture not easily forgotten.

If the writer might be allowed he would suggest that the limits of the Jasper Park forest reserve be extended, say to follow the correction line between the thirteenth and fourteenth base lines, to range 17, and thence southeasterly to cross Brazeau river about range 13 and thence to the correction line between the eleventh and twelfth bases and possibly farther, but that is as far as the writer's observations go. The country embraced is not well adapted to farming of any kind and would take in the head waters of the McLeod and Pembina rivers, which have their source in the foothills, being fed by springs and muskegs and thus prevent their deterioration through lumbering operations. If a few main trails were maintained, the game and fish protected, and a careful system of burning of windfall, and reforestation in the more favoured localities through this tract, a few years of careful and judicious management would, I am sure, show that an asset of inestimable value had been started in Canada. The species of wild animals badly need protection, such as moose, elk, caribou, mountain sheep, and red deer as well as partridge and ptarmigan, whose seasons of grace are not respected by native hunters. These are being rapidly thinned and will, I am convinced, in a few years be nothing to us but memories and names, unless some such preserve is established in the near future. During the time that I was on the west fork of the McLeod, a band of native hunters were at the headwaters of this stream, which is said to be a favourite grazing ground for mountain sheep. Prospectors and others I met in this locality have told of the finding of bodies of these animals shot and allowed to lie, apparently merely to satisfy a lust for blood. If such reserves were made it would not be difficult to prevent illegitimate hunting, as once the Indians and halfbreeds knew such a reservation had been made, and poaching would be punished, there would be little trouble, as they have a healthy and wholesome fear of authority. It, therefore, seems to the writer that with three such worthy objects as preservation of the watersheds of the McLeod and Pembina, reforestation of tracts not fitted for agriculture, and preservation of the game in a tract so eminently suitable for such purpose and when other countries are being rapidly taken up, something surely might be done in the fairest land of them all, to preserve such a portion in its primeval state as would be commensurate with the dignity and future requirements of Canada.

In conclusion, I would like to express my appreciation of the devotion to duty of my assistants, Mr. E. W. Murray, and my head chainman, Mr. R. K. Wickham, as I consider the success of the expedition, such as it was, due in a large measure to these gentlemen. My chainers, I think, established a record, as a four and five chain tape were used in chaining the two hundred miles of line through as rough a country as is generally encountered, without breaking either of them.

Some of the accompanying photographs may be of interest enough to publish, but I regret to say that several of my best exposures taken in the Folding and Fiddle Creek ranges were destroyed by the pony submerging himself and his pack while crossing the creek.

I have the honour to be, sir,

Your obedient servant,

A. H. HAWKINS, D.L.S.

APPENDIX No. 26.

REPORT OF H. S. HOLCROFT, D.L.S.

SURVEYS IN THE PEACE RIVER DISTRICT, 1908.

Toronto, February 17, 1909.

E. Deville, Esq., LL.D.,
Surveyor General,
Ottawa.

Sir,—I have the honour to submit the following report on my operations in the field in Peace River district during the period between February and December, 1908.

In furtherance of your instructions dated December 23, 1907, January 11, 1908, January 30, 1908, and subsequent instructions, I left Toronto on February 23, 1908, and proceeded to Edmonton where I organized a party of thirteen, including myself. Labourers were not scarce, but men of the better class were not very plentiful, and one had to exercise one's discretion in choosing men who are to be out for a protracted period. I left Edmonton on March 12 for Peace River Crossing, via the usual route, *i.e.*, to Athabaska Landing by trail, from there by ice via the Athabaska and Lesser Slave rivers, and Lesser Slave lake to the Lesser Slave Lake settlement at the west end of the lake, thence across the portage to Peace River Crossing where I arrived on March 30. The distance from Edmonton to Peace River Crossing is about three hundred and eighty miles.

Lesser Slave river was open in many places, and the ice for about fifteen miles was covered with water from six inches to one foot deep, and this again with a thin sheet of ice. This ice cut the horses badly and made progress very slow.

I had the greater part of my supplies freighted up as far as Peace River Crossing earlier in the winter of 1908.

When I left Edmonton there was little or no snow on the ground, so I used wagons. Two days out from Edmonton as the snow became deeper, I changed from wagons to sleighs.

My transport now consisted of six horses, two wagons and two sleighs. In Edmonton I had a large rack made for one of the sleighs, and also had fixed up attachments so that I could use four horses. This I found very convenient, as it was not then necessary to double up going up steep hills and through bad places.

Hay was procurable at most of the stopping houses on the way up, but oats could be obtained only at Athabaska Landing, Lesser Slave lake and some at Peace River Crossing.

Directly on my arrival at Peace River Crossing I proceeded up Peace river about thirty miles to run the twenty-first base line across ranges 24, 25 and 26, This had to be done before I could do any of the subdivision work I was instructed to do. The point where I had to start from being back some seven or eight miles from Peace river and up on a hill amongst dense timber; we had to pack our camp outfit and supplies on our backs as there was no feed near for the horses. I completed this fifteen miles of the twenty-first base and then started to subdivide townships 81, ranges 25 and 26 according to my instructions.

In the district in which my work lay, *i.e.*, townships 81 to 84 inclusive, ranges 23 to 26, all west of the fifth meridian, Peace river flows through a valley about three

and one-half or four miles wide. The southeast or right bank is densely wooded down to the junction of Peace and Smoky rivers. The right bank is eight hundred feet high and the slope to the river breaks off quite abruptly at a distance of about one and one-quarter miles back from the river. Farther back the country is nearly level and heavily wooded.

The northeast or left bank contains the better country for farming or ranching. On this side of the river the top of the hill is not reached for a greater distance back than on the right bank, some places as far back as four miles. Near the river there are a few small flats containing a few acres each of level land. Then the hills begin and the country is rough and broken until the top of the hills is reached. This country between the top and bottom of the hill is good only for grazing purposes, being too rough for farming. The plateau is gently rolling and about semi-open, and has good soil consisting of a top soil of black loam from two to twelve inches in depth and a clay subsoil. Fuel in the form of poplar, balm of Gilead, willow and some spruce and tamarack is abundant. Water is rather scarce in some parts, but there are several small lakes and an occasional small slough. Bear lake, Old Wives lake and Burnt river furnish water. In some of the more swampy portions there is also water. There is no reason to believe that water could not be procured by digging wells. Upland hay and peavine can be cut in many places in townships 82 and 83, ranges 24, 25 and 26, and there is lots of meadow hay and slough grass near Burnt river and around Bear lake. The whole country on the top of the hill on the left bank of Peace river from Dunvegan down to Peace River Crossing, and also I believe, in 'Whitemud prairie' is excellent ranching country. I can see no reason why it would not be a good farming country and raise good wheat, oats, barley, &c. There is enough moisture and the soil is good. During the year 1908 the climate was remarkably mild and equable; no frosts occurred that did any damage. Vegetables of all varieties grow luxuriantly, and indigenous vegetation was remarkably profuse. Mr. Thos. Griffin, living in section 33, township 81, range 25, sowed a few acres of wheat, and also of oats, which this year produced very good results, the grain being large, full and hard. Mr. Griffin also had a large vegetable garden that produced excellent potatoes, cabbage, radishes, beet-root, turnips, carrots, lettuce, onions, &c.

The season of 1908 was very dry. This did considerable damage to the crops in the valley of Peace river, but what crops were planted on the top of the hill were a success.

No minerals of value were discovered, though the clay of the country should make good bricks. Some float coal was discovered on the beaches and bars of Peace river.

After I had finished the subdivision of townships 81 ranges 25 and 26, I proceeded on June 20 to lay out an addition to Shaftsbury settlement. In 1906 Mr. H. W. Selby, D.L.S., laid out about eight miles of river front, starting in section 1, township 82, range 24, and proceeding northeasterly down the river. I commenced where Mr. Selby left off and proceeded to survey out settlement lots from there down to directly opposite Peace River Crossing a distance of about eight miles. I also laid out as lot No. 43 an island in Peace river, which is near the shore, and at low water is connected with the mainland.

This new portion of Shaftsbury settlement contains some good level land lying in benches along the river front. In some places it is stony and gravelly, and in some places the hills come right to the edge of the river so that some of the lots are of very little value for farming purposes. I laid out twenty-three lots. I made the direction of the lot lines and the rear lines conform as nearly as possible to the direction of the river. I laid the road allowance out as nearly as possible to conform with the present travelled trail, and to pass also where improvements had been made. I also laid out the lots in such a manner as to give every squatter the improvements he had made. Road allowances running from the main road in the settlement to the rear of the settlement were also laid out at suitable intervals.

Although the water in Peace river rises during the spring floods to a height of fifteen to twenty feet none of the lands are liable to be flooded to any extent.

As I had instructions to survey township 81, range 24, I next started upon this work. I swam my horses across Peace river, and as this township was densely wooded I used a pack train. I hired three pack horses to supplement my transport service, and borrowed some pack saddles from the non-commissioned officer in charge of the R. N. W. M. P. at Peace River Crossing.

I finished the subdivision of this township on October 24, and then ran the east outline of townships 82, ranges 24 and 25. I next commenced to subdivide township 82, range 24. On November 30 the river became filled up with ice and froze over finally on December 1. I waited until I had completed the subdivision of township 82, range 24, and on December 16, started for Edmonton using sleighs. I left my two wagons at Peace River Crossing.

The last two weeks of the work in the mounding was very difficult. Frost was in the ground to a depth of fifteen inches or more and the pits required a lot of labour. The days too, at this time of the year, and in this latitude (56°00′ north latitude) are so short that economical work cannot be done.

The ferry set up this year at Peace River Crossing by the government of the province of Alberta, furnishes a much needed facility for crossing Peace river. Before the ferry was put in one had to cross in canoes or if horses had to go over a barge had to be rowed over which entailed a great deal of trouble and considerable expense as the current of the river is swift here.

Peace river is a fine large river flowing swiftly, but has no rapids or falls to impede navigation between Fort Vermilion and Fort St. John.

In high water the Hudson's Bay Company's shallow draught, flat-bottomed steamboat 'Peace River' goes as high up this river as Hudson's Hope, a considerable distance above Fort St. John.

Anyone going up with horses during the winter of 1908-09 would have to carry oats from Lesser Slave lake westward. At Peace River Crossing the crop of oats was practically destroyed this year by the drought, and oats, if any can be procured at all, will cost about $2.50 a bushel at Peace River Crossing.

One of the great needs of this country is railway communication. At present and for a few years yet ranching or stock-raising can be profitably carried on, but for farming purposes a railway is required, even if it only comes to the south side of Peace river.

The Roman Catholic mission in Shaftsbury settlement have a stone flour mill where wheat and other grains can be ground into flour or feed. They also have a saw and shingle mill, where one can buy finished material or have their raw material cut.

I arrived in Edmonton on December 29, where I paid off the party and stored the remainder of the outfit and arranged to have my horses wintered. I left Edmonton on January 7, and arrived in Toronto January 12, 1909.

I have the honour to be, sir,
Your obedient servant,

H. S. HOLCROFT, D.L.S.

APPENDIX No. 27.

REPORT OF ERNEST W. HUBBELL, D.L.S.

INSPECTION OF SURVEY CONTRACTS IN THE PROVINCES OF MANITOBA AND SASKATCHEWAN.

OTTAWA, February 20, 1909.

E. DEVILLE, Esq., LL.D.,
Surveyor General,
Ottawa.

SIR,—I have the honour to submit the following general report of my field operations on the inspection of survey contracts in the northern part of Manitoba and in Saskatchewan for the season of 1908.

In accordance with your general instructions dated April 7 I left headquarters as soon as I had collected the necessary data and paraphernalia requisite for a sojourn of eight months or more in the field. Arriving at Prince Albert (my organizing station) on April 20, I found a portion of my survey party encamped, as prearranged. It was fortunate that this had been done, as the breaking up of the ice in South Saskatchewan river would have prevented our crossing for several days; as my survey outfit and horses were in winter quarters on the south side of the river, we would have been detained some time awaiting the outfit of the ferry, which is still in use at this place, a constant reminder of the primitive methods employed in crossing rivers in the early days when steel bridges were an unknown quantity.

For the next few days we were engaged in overhauling and collecting transport outfit, engaging men, ordering supplies, making repairs, &c. By the 24th the river was clear of ice, and the following day (Saturday) the ferry was in operation across the river. As one of my horses had died during the winter and another a few days after we had them in camp, it was necessary to replace them by purchasing another team. This I did after considerable difficulty, as the right stamp of horse was hard to purchase at a reasonable figure, and good horses in the spring of the year are high priced, averaging from three to five hundred dollars per team.

It may be somewhat of a surprise to many who knew Prince Albert a few years ago to learn of the vast improvements that are being made almost daily in this city; for a city it is now, with a population of over 7,000. There are many beautiful buildings, including post-office and land-office combined, jail, city hall, convents, schools, banks, also some handsome stores and up-to-date hotels.

The city itself is most picturesque, situated in north latitude 53° 10′, longitude 106°, and 1,398 feet above sea-level, on the banks of Saskatchewan river, surrounded by hills covered with timber of various kinds. There are several mills, lumbering being the chief enterprise. The Canadian Northern Railway company has about completed a magnificent steel combined railway and general traffic bridge across the river immediately in front of the city in connection with the extension of their line to Battleford. This when finished will be of incalculable value to the residents in the surrounding district. Property in Prince Albert has more than quadrupled in value in the past few years and new stores, mills and private residences are constantly under construction. A very small percentage of the land within a forty mile radius of the city is under cultivation, the greater portion doubtless being under the control of speculators. This, of course, is a detriment to the natural advantages and possibilities of this fertile belt. Owing to the almost inexhaustible resources of tim-

ber, minerals and game to the north, it does not require much perspicacity to prophesy an extensive and prosperous community in this vicinity which for many years has been lying dormant. To the east, west and south, is an ideal mixed farming district, where grain and vegetables of all varieties are raised in great abundance. The soil is excellent and suitable for the production of all varieties of grain and vegetables. There is a continuous and excellent supply of fresh water everywhere, and the climate is delightful. Who is there that can even faintly estimate the wonderful resources of this almost unknown country to the north, when it is a well known fact that wheat for the past seven consecutive years has been successfully raised at Stanley Mission, one hundred and fifty miles north of Prince Albert?

On April 27, we pulled out of Prince Albert, crossed the river on the ferry, and proceeded east-northeasterly along the Candle lake trail for forty miles, in the direction of my first work, which was the inspection of contract No. 13 of 1907, comprising townships 50 and 51, ranges 19, 20 and 21, west of the second meridian.

We experienced great difficulty in taking our outfit into this country, having to cut and brush miles of trails, build numerous bridges, corduroy mud-holes and use six horses to almost empty wagons. In addition, the incessant attack of flies allowed no rest to man or beast, night or day. There was a snowstorm two days previous to our departure from Prince Albert, which if possible, rendered the trails worse. As a great portion of this section of the country over which we passed is covered with large muskegs, it was most trying on the horses, especially so as there was no grass for them at that time of the year. We completed the inspection of this work on May 30.

The townships comprising this contract are all heavily wooded with poplar, some spruce, and jackpine, a fair portion being suitable for manufacturing purposes. There are numerous sloughs and muskegs, with sand ridges intervening, covered with jackpine. The soil is principally sand, a great portion is unfit for agricultural purposes. Whitefox river, a stream varying in width from two to three chains and from three to six feet deep (according to the season of the year), flowing easterly across townships 51, ranges 19, 20 and 21, proved an impediment to our progress, as we had to cross it at different places, necessitating the building of several bridges. There are no settlers or inhabitants in this section of the country, but game of all varieties is most plentiful, especially moose and elk.

Being unable to retrace our steps over the route we came by, on account of the frost being out of the muskegs, we had no choice but to cross the Saskatchewan river at Fort à la Corne, where we arrived on June 2, and experienced unusual difficulty in taking our outfit across the river, as the only means available was a small sheet-iron boat. I may say that this was a rather precarious operation, but the great danger lay in swimming our horses, as the current is swift, the river is wide and the shore on the south side of the river quicksand. It was with thankful hearts we saw the last man across in safety. From here we proceeded towards Prince Albert, passing through a beautiful fertile country, presenting so marked a contrast to that just passed over that it was hard to realize that the only difference lay in being on the south side of the Saskatchewan river. For the first time our horses were able to obtain a plentiful supply of good grass.

On the 5th we crossed the South Saskatchewan river at Merkley's ferry, and arrived at Prince Albert the following day, passing on our way several cattle that had been killed by black flies.

Again recrossing Saskatchewan river we followed the Sturgeon lake trail and on June 10 arrived at township 52, range 1, west of the third meridian, a portion of contract No. 20 of 1907, that had not been inspected.

We again experienced the usual difficulty in gaining access to our work, on account of bad trails, having often to cut out and make our own. Townships 52, ranges 1 and 2, west of the third meridian, are thickly covered with spruce, poplar, hazel and willow, a fair portion being suitable for manufacturing purposes, although

the greater part has been cut, as these townships form part of a timber limit. We came across several vacated lumber camps. In this part of the country there are many muskegs and sloughs; the soil is generally sandy loam and well adapted for agricultural purposes. There appeared to be no settlers in this vicinity. Whilst at work here, the sand flies, bulldogs and mosquitoes were almost unbearable, neither man nor beast being able to obtain a night's rest. Upon the completion of the inspection of this work, we again moved camp to Prince Albert, arriving there on June 17. Owing to the very high water in the river (caused by the usual freshet from the mountains) and thousands of sawlogs which had broken loose from a boom at Edmonton, the ferry was unable to cross; consequently we were delayed two days and a half.

The trails still continuing to remain unusually wet, I endeavoured to move my outfit by rail from Prince Albert to Tisdale, but was unsuccessful, owing to the irregularity of the train service, caused by inundation of the track in various places.

On June 20 we crossed the Saskatchewan and, on the 22nd, the south branch on our way to Tisdale, distant about one hundred miles, arriving there on the 27th after a week's travelling made arduous by trails well nigh impassable. The portion of country passed over might be called the garden of the Prince Albert district, being well settled, with large areas under cultivation. The soil is excellent, the surface fairly level and about half covered with poplar and willow, with plenty of good water. The harvest yield is exceptionally plentiful, the settlers apparently prosperous and content.

From Tisdale we proceeded southerly to inspect townships 42 and 43, range 12, west of the second meridian, a portion of contract No. 7 of 1907.

Owing to almost continuous rain there was no improvement in the trails, in fact they were so bad that I was perforce obliged to hire additional transport, my own horses showing symptoms of collapse. In order to gain access to these townships, we were compelled to pack a portion of the outfit on our backs, across an immense muskeg extending for miles.

These townships are practically all covered with timber and muskegs and it is most difficult to carry on the work of inspection. So shaky and wet was the ground that it was next to impossible to set up an instrument with any degree of solidity, although long hubs were constantly used. We were in water three-fourths of the time—in fact slept in it. There is a fair quantity of merchantable timber in these townships, principally poplar: there are also a number of quarter sections suitable for homesteading—in fact several are already taken and, doubtless, when trails are passable many more will be entered for, as the soil is of good quality. Red Deer river flows through township 42, range 12, and is the water route for logs from the lumber camps to various sawmills along the Canadian Northern railway.

On July 8 we again arrived at Tisdale and, as authorized, engaged a box car to finish the inspection of contract No. 7, which extends along both sides of the Canadian Northern railway for a distance of one hundred and thirty miles and well into the province of Manitoba.

This portion of the country inspected is about sixty per cent muskeg, and at the time of inspection (July) was nearly under water, which in many places covered the railway track to such an extent as to almost demoralize freight traffic; wrecks were of frequent occurrence and the transport of freight for a time was suspended. The soil, generally speaking, is unfit for agricultural purposes. There are but few trails and no settlement away from the railway stations. All the country embraced in this contract is practically covered with heavy timber, consisting of spruce, poplar, tamarack, birch, elm and thick underbrush of willow, alder, cherry and hazel. A considerable portion of the timber is suitable for manufacturing purposes and at nearly every railway station there is a sawmill, with output varying from 300,000 to 800,000 feet a day. The most important mill is at Barrows, on Red Deer lake, to which a branch railway is constructed and operated. Whilst engaged upon this work the heat was excessive, 96° in the shade not being uncommon. For about a month we lived in the box car, shunted

and moved from time to time as was most expedient or suitable to the railway officials, who on the whole treated us fairly well, although at times our car was placed between cars loaded with huge piles of lumber (a violation of the Railway Act), or again between open flat cars loaded with logs or ties, truly not an enviable position, when the condition of the track is considered. However, it was the only method that could be adopted to carry on the survey successfully, as it was out of the question to move horses across the muskegs.

I may add that fully sixty-five per cent of the country along the railway from Tisdale to Woody river, one hundred and sixty miles, is totally unfit for agricultural purposes. I think the contractor, Mr. McFarlane, deserves credit for successfully conducting his survey under many adverse circumstances through this district. Upon the completion of the inspection of this contract on July 28, we were moved by train from Novia, the eastern terminus of the contract, forty-three miles to Swan river, and from here I sent two men to Tisdale to bring by train my horses, which had been in pasture during the inspection of the contract.

Not having been in Swan River for about eight years, I was agreeably surprised at the progress the town had made since my last visit, and especially at the number of substantial and pretty residences that had been erected.

The Canadian Northern Railway company has built a branch line from Swan River southwesterly and had under operation about thirty miles, the terminus being a small but thriving town called Benito. From there they were constructing the line westerly and expected to complete about forty miles before the winter. This line will open up a new section of the country and be of great advantage to the numerous settlers now flocking into this fertile district.

On August 6, I commenced the inspection of contract No. 11 of 1907 and completed this work on the 13th.

The greater portion of the country passed over on our trip from Swan river to this contract, about eighty-five miles, is covered with timber, poplar predominating. The soil is sandy loam, suitable for the production of wheat, oats and vegetables. It is not as yet thickly settled, but, having many advantages, there is no doubt that it will be, in the near future.

The country comprising contract No. 11, townships 37 and 38, ranges 1, 2 and 3, west of the second meridian, is generally hilly and covered with fair-sized poplar, spruce and tamarack. Adjoining both sides of Swan river, a stream about one hundred and ten links wide and from two to six feet deep, which flows through this contract, are numerous sloughs and muskegs, which, although fairly dry at the time of inspection (August), are no doubt quite wet during the rainy months.

From here we had to cut many miles of trails in order to inspect the remaining contracts, which were scattered over a large area of this portion of Saskatchewan; our progress was therefore necessarily slow.

On August 15, we commenced the inspection of that portion of contract No. 6 of 1907 comprising townships 37, ranges 5 and 6, and townships 38, ranges 4, 5 and 6, west of the second meridian, and completed the same on the 20th.

The country comprising this portion of contract No. 6 is comparatively hilly, and mostly covered with poplar, tamarack, willow and some spruce, with numerous sloughs and muskegs intervening. There are also a few large lakes, several creeks and some open spaces.

There is but one trail that passes through this portion of the contract, the only settlers being a few Galicians. There is a small mill situated in the southeast quarter of section 10, township 38, range 5. The soil is generally sandy loam with a little gravel here and there.

The Etoimami lakes are situated in townships 37 and 38, range 5, and, as their Indian name implies, are situated on the height of land. It is from these lakes that the north and south Etoimami rivers, which flow in opposite directions, have their source.

Whilst encamped here we were visited by a large band of Saulteux Indians who were on a moose hunt. They were painted in all the colours of the rainbow and were most picturesque,—a formidable outfit, as each man was armed with a rifle of improved pattern. I presume a considerable slaughter of game took place. This was not the only occasion that came under my notice of Indians killing game out of season, which, if persisted in, will soon exterminate all the larger game in the country.

From here I proceeded to Kelvington postoffice, where we received a month's mail, and from there to Little Nut lake, where I received a telegram notifying me of the death of Mr. Edgar Bray, D.L.S., and requesting me to return to his contract, complete the inspection and look after the disposal of his party. This I accordingly did, driving to Wadena, fifty-five miles, for the purpose, where I took the train to Kamsack, from which place I travelled by trail to Fort Pelly, twenty-two miles. After completing the inspection of the late Mr. Bray's contract and reporting fully thereon to the Department, I returned to my survey camp,

I then completed the inspection of contract No. 6, comprising townships 38, ranges 10 and 11. The work done in these two townships, as in the other portion of this contract, was particularly well done.

We next inspected a portion of contract No. 27 of 1907, consisting of townships 39 and 40, range 11, and township 40, range 10, west of the second meridian. This section of the country is mostly covered with small poplar, willow and some spruce, with a few small areas of prairie. The soil is excellent, the surface generally level and well watered by lakes and creeks. The largest lake is Little Nut lake, which is about three miles in diameter.

Red Deer river, a stream of considerable importance, about three chains in width and four to eight feet deep, used for floating sawlogs to the mills, flows across these townships. This country is admirably adapted for farming. As usual, we had difficulty in taking our outfit through this district, there being no trails of value to us.

We next proceeded to townships 42 and 43, ranges 9, 10 and 11, west of the second meridian, the remaining portion of contracts Nos. 27 and 28 of 1907.

Commencing work on September 10, we completed the inspection on September 23.

As usual, we had to cut miles of trail in order to gain access to these townships, which are nearly all covered with poplar, willow and some scattered clumps of spruce. There are also numerous small lakes and muskegs. The surface on the whole may be classed as undulating, the soil sandy loam suitable for the production of all kinds of grain and vegetables.

There are no settlers in this district, nor are there any trails.

The work of the contractors in these townships was of a superior order.

In the course of our manoeuvres we several times crossed Red Deer river, a small stream previously referred to.

On September 26, we moved camp eighteen miles, along an old trail to Crooked River, a small village on the Canadian Northern railway whose chief enterprise is lumbering, and which possesses a sawmill employing about fifty men.

From here we proceeded to Tisdale, twenty-two miles, following a bush trail that would be impassable in the summer months. The country passed over is all thickly timbered and there is no settlement.

Remaining in camp at Tisdale one day to repair our dilapidated outfit and complete some final returns, we next proceeded to township 42, range 16, and finished the inspection of the remaining portion of contract No. 28 on October 9. The country passed over is an ideal farming district, about sixty per cent covered with timber. There are numerous settlers throughout this district, which is well supplied with good water, graded trails, and soil of fair quality.

The work of the contractor, Mr. Cautley, in the townships comprising this portion of contract No. 28 was by far the best work examined during the entire season,

and too much credit cannot be given for the great care shown by him in the opening, cleaning and draining of lines. Our next work was the mounding of the east boundary of townships 39 and 40, range 17, and verifying the marking of a witness mound at the northeast corner of township 39, range 16. This corner is on a small island in a large lake, and in order to get there we had to construct a raft. On October 13, we started for Prince Albert, where we arrived October 22. On this trip we passed over a great portion of country previously described, and on account of several heavy rains were unable to travel continuously. From Prince Albert we again crossed Saskatchewan river and moved our outfit into township 52, range 3, west of the third meridian (contract No. 11 of 1908) and commenced inspection on October 27, finishing the same on November 4.

Townships 52, ranges 3 and 4, were the only townships finished in this contract. They are almost covered with timber, principally poplar with considerable spruce, of which a good portion is suitable for manufacturing and other purposes. These townships are included in a timber reserve granted to the Prince Albert lumber company. There are no settlers, and but one trail runs across the northern part of the townships to Stump lake, where a large sawmill is in operation.

Until the timber is cleared from this district there is very little chance of settlement.

There are several lakes in this vicinity which teem with fish. Whilst at work here we traversed several lakes, some of which it would be next to impossible to traverse in the summer.

On November 5, we started for township 47, range 11, west of the third meridian (contract No. 21 of 1907), where we arrived November 12. Owing to rain and snow the trails were soft and sticky.

We finished the inspection of this contract on November 21, a detailed report of which was forwarded you. From here we moved camp to Prince Albert, arriving there on December 2. During the course of our inspection, extending over a period of eight months, we travelled by trail many hundreds of miles, covering a large area, principally wooded, in the northern portion of the province of Saskatchewan.

CLIMATE.

Speaking generally, the weather conditions were unfavourable for surveying operations, as during the season we had fifty rainy days; for days at a time we failed to see the sun, and atmospheric conditions were against observations on Polaris. We therefore had to resort in many instances to sun observations. On April 21, the ice was out of Saskatchewan river, which was again frozen over on November 21. The snow was practically gone by April 24, and its first appearance of any account was the first week in November. The greatest quantity of rain fell during the month of June (fifteen days). We had slight frost every month except July. The hottest day was July 25, the thermometer registering 96° in the shade. The coldest day was December 1, 40° below zero. The first snow fell on September 23, and on November 16 the snow was ten inches deep and the ice twelve inches thick. Sloughs were frozen over on October 28.

In my many experiences in surveying I have never seen the number of mosquitoes, black flies, bull dogs and 'no-see-ems' equalled; they commenced May 5 and smudges were necessary until September 23. When moving camp the horses were kept blanketed and quantities of fly oil used.

On May 9, we were invaded by a swarm of flying ants of unusual size, measuring fully three-fourths of an inch in length. After settling down they proceeded to divest themselves of their wings.

When taken into consideration that horses are our only means of transport, it will readily be admitted that they should be of the best, particularly so on inspection work, as in that case the driving is more continuous and distances much farther

than in ordinary survey work, and now that contracts are chiefly in wooded country, and likely to remain so, transportation through such country is doubly hard and most trying on horses, more especially in the spring of the year when trails are almost impassable, little or no fodder obtainable, and the horses generally in poor condition. Swamp fever, a prevalent epidemic in various parts of the west, is most disastrous, as many horses die from it and others sick with it are useless to the surveyor for most of the season.

During my peregrinations I passed through several Doukhobor villages and was agreeably surprised to find such good progress made, particularly in the cultivation of land. Several informed me that they had ceased to acknowledge Peter Veregin as their leader, and were working on their own responsibility.

We did not perceive any indications of minerals or coal, although it was reported that a rich vein of gold was discovered at Lac la Plonge, one hundred and fifty miles north of Prince Albert.

Great quantities of game, both large and small, abound throughout this district.

In conclusion, permit me to place on record my appreciation of the valuable services rendered by my two assistants, Messrs. W. G. McGeorge, of Chatham, Ontario, and Sydney D. Fawcett, of Ottawa. Both these gentlemen vied with each other in the performance of their duties, which they accomplished in a satisfactory manner.

The innovation of appointing two assistants to each inspector proved most satisfactory, as it enabled the inspector to forward to head office without delay the final returns of inspection, thus allowing the office staff to compare and check the contractor's notes and returns, effecting an early settlement.

I have the honour to be, sir,
Your obedient servant,

E. W. HUBBELL, D.L.S.

APPENDIX No. 28.

REPORT OF ALFRED W. JOHNSON, D.L.S.

SURVEYS IN THE WESTERN PORTION OF THE RAILWAY BELT, BRITISH COLUMBIA.

KAMLOOPS, January 22, 1909.

E. DEVILLE, Esq., LL.D.,
Surveyor General,
Ottawa.

SIR,—I have the honour to submit the following report on my season's work in 1908.

I left Kamloops on February 13 and began work at Hope. There were some corrections to be made in the survey of the townsite and I ran one or two lines over what is called Little mountain, besides making some connections between the old lots west of Hope and the Dominion system surveys.

Two weeks later we moved up to Yale by canoe, a feat I would not attempt again with loaded canoes unless there was absolutely no other way of getting up. The river is full of rapids that are dangerous for any one but seasoned Indians to pole up, and it was more by good luck than anything else that we got to Yale without casualties.

We were at Yale for six weeks making a resurvey of the suburban lots west of the town and of the crown-granted lots between that place and Choate. The original notes of the suburban lots were destroyed in the New Westminster fire, and though there are some copies of various old plans extant they do not agree very well.

There are, however, one or two corners of fences about the position of which there is no reasonable doubt, and I had the invaluable assistance of Mr. McKenzie, Dominion lands agent at New Westminster, so that the resulting survey is probably as near the original as it is possible to get it now.

It would be well if every owner of a piece of land would first of all take the trouble to find out where his corners are when he comes into possession and, secondly, mark such corners by something not easily effaceable. People have no idea at all how difficult it is to re-establish corners. Many consider that you are wasting the Government money if you go any distance from the desired corner to pick up some known point to work from.

These suburban lots are on a hill facing south and, though stony, grow very good fruit. Mr. Wm. Teague has russet apples that I think would be hard to beat anywhere and the Yale cherries are proverbial in British Columbia. There is a lot of this side-hill land between the town and Hope, and where it has been cleared excellent fruit is grown. But clearing is so very tedious and expensive that one hesitates to advise people with no capital to go on to a bush place. For men with a steady income in search of a beautiful country and a mild climate this part of the Fraser valley offers great attractions.

In the middle of April we took to the water again and ran the rapids at a higher stage of water than when we came up. There is some compensation about canoeing when you are going down stream, even in a gale of wind, and we got well settled in camp at Ruby Creek the same day.

There were a couple of new lines to run here but they unfortunately led over a totally inaccessible precipice so the work took longer than would appear necessary.

Mr. C. D. Brown, as first assistant, and Mr. C. A. Morris, as second, had joined me at Yale. It is a very great help to have a man with you who can take charge of a

transit. There are often times when you can have two parties out at the same time, each consisting of three or four men, and in this way more work can be done.

Two weeks later we canoed to Rosedale, landed and having hidden the canoes in the bush above high water line, moved by wagon to Rosedale, where we camped in a swamp.

There are some new settlers on the hills under Elk falls and I ran some section lines for them. These foothills rise to a height of nearly a thousand feet above the Chilliwak plain, and taken as a whole are not quite as difficult to clear as the average coast land. The soil is good for fruit and no irrigation is necessary. They are not more than five miles from the Fraser at Rosedale landing, and I think that much activity will be shown in this place.

The weather was distinctly wet even for this district while we were there, and we were in a swamp to begin with and were practically camping in a lake when we left.

The middle of May saw us on board the canoes again en route for Harrison river, where I ran some new lines between the river and the mountains and traversed a small lake where a new settler has begun a clearing.

This part has been logged and there are one or two good skid roads that would be of much use to intending settlers. The great drawback at present is that Harrison river is the only means of communication with the Canadian Pacific railway.

I left my canoes here and went to Keefers to do mountain work. In traversing up the Similkameen trail in 1906 I found a discrepancy in the position of the posts on the railway belt limit in the Canyon trail according to this traverse. My instructions were to find where this discrepancy was. I, therefore, determined to work across the mountains from Keefers to Spius creek to see whether the limit was correct at that point. I laid off a base at Keefers and sent two men on ahead over the mountains to put in stations on prominent peaks. Before doing this we ran some section lines below Keefers in the Nahatlatch river valley. My pack train had wintered at Keefers and it was necessary to swim them across to the east bank of the Fraser, and we did this one memorable afternoon. A canoe led the way with two horses in tow and we drove the others in after them. The river was in flood and running like a mill-race, the horses were no sooner in the water than they passed out of our sphere of influence, down stream. They got half way over without much difficulty, except that one of the led ones passed completely under the canoe and nearly upset it. At midstream, for some unknown reason, one of the horses in the middle of the line turned around and swam back. All those behind him followed suit and in ones and twos, strung out for a mile below where they went in, they struggled out. The rest of the afternoon was a nightmare of finding horses in all sorts of inaccesible places, roping them to the canoe and taking them over one or two at a time. One of them, an outlaw called Satan, fought like a fiend. Time after time we drove him into the river and as often he fought his way back dragging the canoe with him. At last they were all safely across and pastured on the Indian reserve.

We made an attempt to follow the triangulation with the pack train, but after climbing to a camp 5,000 feet above the river and finding all routes closed by six feet of snow, we abandoned the idea and I sent the pack train with most of the men around by the Boston Bar trail. Then I got two or three horses to take provisions and outfit for myself and one Indian, two days climb up another mountain and after that he and I packed across the mountains by man pack.

We had bad weather. For nearly a week the clouds refused to lift and for two days we sat huddled up under a signal tripod with no sleep and nothing much to eat, while a snow storm lasted, but on the twelfth day we pulled into the horse camp on Spius creek. When after some days delay, on account of clouds, we got our final angles on the railway belt limit, I found that at that place it was correct. If therefore, there was a mistake on the belt, it must be between Spius creek and the Similkameen trail. So I left half my horses and men with Mr. Brown, with instructions to run the belt

limit section line by section line, chaining carefully and taking numerous observations for azimuth, southwards until he met me again.

I myself went down to Hope, laid off a base in the townsite and triangulated over the mountains, with stations on both sides of the Similkameen trail, to the Canyon trail, as a check on my traverse in 1906. These mountains are high and very steep, but fortunately I had a man in the party who could be trusted to read the less important angles and I gave him a transit and the southwest side to work up while I took the northeast. There were, therefore three parties using instruments at this time. After the usual misadventures of mountain work such as packing water 1,500 feet to a signal and draining rain off our blankets for tea and so on, I tied on to four separate section corners on the railway belt limit by triangulation and found that my traverse was correct, whereupon I checked the actual lines of the limit going north. Mr. Brown and I met on the south fork of the Tulameen and neither of us had found any error that would account for the one we were looking for. Therefore, I regret to say that though there is a mistake somewhere I cannot find it in my own work.

While the pack trains, carrying among other things a man who had cut his leg with an axe, were working back to Hope down the Canyon and Similkameen trails I took one Indian and went up to Coutlee to check a line that I thought, as a last chance, might be wrong. I found it correct and by dint of walking forty-seven miles, most of it during the night, got into Spence Bridge next morning.

I reported this result to you at the time and went on with other work, sending the pack train up to Kamloops for the winter. We ran a few lines near Suicide creek at Dewdney and then moved to Abbotsford. This was all resurvey and I was fortunate in obtaining good evidence for re-establishing the corners. This is a long settled district and there are many roads nearly all of which follow the section lines. A certain distance was taken on each side of the line for the road, and corners are in the middle of the roads.

In re-establishing these I sank iron posts in small piles of stones completely underground, in some places putting bearing trees too. I do not know of any other really safe way of marking such corners. I also re-established some corners along the international boundary and was very lucky in getting old bearing trees that nobody had been able to find.

From Abbottsford we went to the edge of the Pitt meadows near Port Hammond. There was a discrepancy in different systems of survey and I carried my lines in from the Canadian Pacific traverse surveys on the railway to make sure of them.

The summer and fall up to the end of September were very fine indeed. There was practically no rain from July 1 to the end of September. It was natural therefore that at Hammond and more particularly at Agassiz we should have a lot of rain. At the latter place it was very heavy indeed and we did a good deal of work in water up to our knees. Agassiz is a very fine farming country and the land is valuable. It was on that account more difficult than in most other places, even to get people to agree about their corners. However, in the instances where there was much dispute I managed to get papers from the adjoining land holders to say that they were satisfied.

On November 19, we went up to Lytton and after doing a small piece of work on the buttresses of Bothanie mountain, moved south of the town to lots 7 and 8, group 1. These I resurveyed after going very carefully over them with the old notes. Besides running three miles of section lines and traversing the east bank of the Fraser I tied on to he adjoining Indian reserves and reposted all corners I came across.

On December 17, I paid off the party and went up to Kamloops.

I have the honour to be, sir,
Your obedient servant,

ALFRED W. JOHNSON, D.L.S.

APPENDIX No. 29.

REPORT OF G. J. LONERGAN, D.L.S.

SURVEYS AND INSPECTION OF CONTRACT SURVEYS IN THE EDMONTON DISTRICT.

BUCKINGHAM, QUE., February 22, 1909.

E. DEVILLE, Esq., LL.D.,
Surveyor General,
Ottawa.

SIR,—I have the honour to submit the following report of my surveys and inspection of surveys in the Edmonton district during the past season.

Acting on your instructions dated March 19, I left home for Edmonton on the 28th arriving there on April 4. As my assistants were not to arrive until the end of the month, I engaged a few men and started to re-post the southerly two-thirds of township 51, range 26, west of the fourth meridian. Although this township is only twenty miles from Edmonton there are practically no improvements. In the north part of it the soil is good but to the south and centre it is either marshes, lakes or rolling sand hills. The lakes and marshes are principally held in place by old beaver dams, where if a couple of hundred dollars were spent, to loosen up the dams, a few thousand acres of good land would be available and would either produce an abundant supply of good hay or be fit for agriculture.

As soon as the grass was long enough so that there was sufficient feed for horses, I started to inspect Mr. M. W. Hopkins' contract, after doing which I returned to Saddle Lake settlement and received your instructions to go to Goodfish to make a traverse of part of Goodfish lake and to settle a difficulty as to the boundary of part of the Indian reserve and Government land. I requested Mr. Batty, the Indian agent, to help in this matter. We called a meeting of the chief and his councillors, and after an explanation of what the difficulty was and a walk over the ground, an agreement was arrived at and the necessary papers signed. I then put in permanent boundaries and when it was completed returned to Fort Saskatchewan, where I re-posted townships 54 and 55, ranges 20 and 21. Having completed this work I moved to Strathcona, where I loaded the outfit on a train and went to Stettler, then drove to the Hand hills and inspected Mr. Lewis Bolton's contract. The Canadian Pacific railway accommodation was so poor that I drove back to Edmonton almost as cheaply as if I had travelled by train.

I purchased supplies at Edmonton and started on another trip, via Athabaska Landing, lac la Biche, Goodfish, Saddle lake, Pakan and Edmonton, inspecting the contracts of Messrs. R. H. Knight, L. R. Ord, J. L. Cote, W. H. Waddell and H. McGrandle. Returning to Edmonton I reduced the party and drove to old Fort Assiniboia, inspected Mr. Fairchild's contract and traversed a few small lakes. As this completed the season's work, I placed my horses for the winter months with Mr. Angus McDonell of Ray, whose past work is worthy of praise. He gives the best of satisfaction, turning the horses over in good working condition. I then took a couple of men and an assistant and went by train to Vegreville and Vermilion, where I made a traverse of four lakes. When this was completed I returned to Edmonton and made preparations to come east.

I would like to call the attention of prospective settlers to a tract of good land extending from Athabaska Landing about twenty miles south, both east and west of

the trail along the river, east even as far as lac la Biche. The country was at one time an immense spruce forest but repeated fires have reduced it to a light scrub. The soil is a few inches of black loam and a clay subsoil and there is an abundant supply of good water. At present a railway is about seventy-five miles distant but there is no doubt that before five years there will be a railroad through the district. Athabaska Landing is a good market and will be until a railway comes. Oats are worth seventy-five cents, and potatoes a dollar and a half, &c. The only reason I can see why this land was not taken up long ago is that the trail to the Landing passes through a deep sandy valley, giving the impression that the land is no good, but once you are up on the benches the wonder is that such good land was not long ago taken up. As a further proof that the country is good, two of my men who came to work on the survey for the express purpose of seeing and taking up land, after travelling all summer, took up homesteads at this place.

To adequately protect the country against forest fires a regular patrol system is required such as the police system in a city, where every officer would have a beat and be obliged to cover every day with an officer in charge to see that those duties are performed. A severe penalty should be provided and strictly enforced for any person who leaves a fire burning either during the danger season or out of it. I would strongly advise that no fire of any kind be left either during the danger season or out of it, as this to a certain extent gives the people the privilege of judging if there is danger; therefore, fires are left, a wind comes up, and from one to ten thousand or more acres of virgin forest are destroyed. It requires only a few moments consideration to realize the loss from inefficient fire protection and that in a few years the natural inheritance of the settler will be gone.

The West will in about another year have three systems of transcontinental railway service, but, at the present rate of immigration, before many years a fourth and fifth system will be required and, since rates are regulated to a great extent by competition, and more particularly competition by water, I think a thorough examination of the Saskatchewan river with the end in view of connecting the east slope of the Rocky mountains with the Atlantic ocean, either by way of Hudson bay or the Georgian Bay canal should be given serious thought. Taking a bird's eye view of the country from the Atlantic to the Rocky mountains it looks like a gigantic undertaking, something impossible, but that view must be relegated to the 'old-fashioned.' We are living in an age of progress, an age where nothing is impossible. Some will say, 'The Saskatchewan river is too swift and the bottom consists of shifting sand bars.' To these I would reply, 'Dam the river every forty or fifty miles and put in a lift lock.' The dams will make a waterfall, which can be used to develop mechanical power, and on the banks factories can be built to manufacture the products of the country at home. To dam the river is not an impossibility, as can be proved by the damming of the Nile in Egypt. Saskatchewan river has high banks on both sides; the back water would do no damage; there would be no current and consequently no shifting sand bars.

In olden times the Hudson's Bay company brought out their furs and took in supplies by means of York boats. Therefore, to-day it is possible to deepen the same waterway and have a twenty-one foot water service all the way across the continent. If the Government will undertake to complete this work the future sons of Canada from generation to generation will read their names in history with respect and say 'They are the men who made Canada for Canadians.'

I have the honour to be, sir,
Your obedient servant,

G. J. LONERGAN, D.L.S.

APPENDIX No. 30.

REPORT OF A. McFEE, D.L.S.

RESURVEY OF THE BOUNDARY OF BUFFALO PARK RESERVE.

Red Deer, Alberta, February 10, 1909.

E. Deville, Esq., LL.D.,
Surveyor General,
Ottawa.

Sir,—I have the honour, in accordance with your instructions of March 16, 1908, to submit the following report of the resurvey of Buffalo Park reserve boundary, situated in townships 42 and 43, range 6, townships 42, 43 and 44, ranges 7 and 8, and township 43, range 9, all west of the fourth meridian.

Taking one man with me, I left Red Deer, Alberta, on April 23 for Battleford, Saskatchewan, for the purpose of taking over the transport outfit that Mr. David Beatty, D.L.S., had used during the season of 1907, and which was left with a man named Sayer to winter. I got the outfit, had it shipped by the Canadian Northern railway to Vermilion and from there had it driven across the country to Hardisty, where the party and outfit joined on May 1, and got to work in the field on the 4th. Commencing at the northeast corner of section 23, township 43, range 9, west of the fourth meridian, running south, I retraced the original surveyed lines, restoring monuments where necessary. Iron posts marked '¼' on the flat sides facing the direction of the line were planted at all quarter section corners where they were required. Along the centre line of a section, according to where the park boundary was located, pickets of a uniform size were driven solid in the ground at frequent and suitable intervals. Where the park boundary followed along the north or east side of a road allowance I placed pickets by offsetting them one chain at right angles to the original surveyed line.

The country throughout the whole park, as well as what I could see surrounding it, is well watered, has good grass, is rather hilly and rough, with scattering bluffs of poplar and willow. It is park like, has numerous lakes and coulées, and the soil is light with three to four inches of sandy loam on sandy subsoil. Ribstone creek runs through the southeast corner of it, having wide flats along each side, where almost any quantity of good blue-joint and slough hay can be cut. There is only one squatter inside the park, on the northeast quarter of section 4, township 43, range 6. There are some beautiful lakes in the northeast corner of the park near Wainwright, on the Grand Trunk Pacific railway. There is an old trail called the Battleford trail running diagonally across the park from near Hardisty to Wainwright. The northwest part of our work ran through a hilly and rough country, with deep ravines and gulches leading to Battle river. A large portion of the country in the vicinity of the park is suitable for mixed farming, with plenty of wood for fuel. I did not notice any coal or rock. Small game such as ducks, plover, snipe and prairie-chickens are plentiful, but we did not come across any large game. No frost occurred during the time I was in the field.

I have the honour to be, sir,
Your obedient servant,

A. McFEE, D.L.S.

SESSIONAL PAPER No. 25b

APPENDIX No. 31

REPORT OF GEORGE McMILLAN, D.L.S.

MISCELLANEOUS RESURVEYS IN CENTRAL SASKATCHEWAN.

OTTAWA, February 10, 1909.

E. DEVILLE, Esq., LL.D.,
Surveyor General,
Ottawa.

SIR,—I have the honour to submit the following report on my survey operations in the province of Saskatchewan during the season of 1908.

In compliance with your instructions, dated April 21, I left Ottawa on the 28th and proceeded to Lac du Bonnet, Man., to procure the outfit assigned to me.

From there I proceeded to Saskatoon, arriving there on May 7. I at once organized my party and started for township 35, range 5, west of the third meridian, where I did seven miles of resurvey. The sky was clouded all the time and prevented my getting an observation. This township is almost entirely a rolling prairie, and the soil is of a good quality of sand. It is well settled, and to a large extent cultivated. Considerable wheat and oats are raised, and the settlers are apparently prosperous. Good water can be easily procured. There are some small bluffs of second growth poplar; these are as yet unimportant, but they are guarded and protected. I finished my work in this township on May 18, and left for township 49, range 25, west of the second meridian, and, having driven all the way, I reached there on June 1.

While in this township the rainfall was excessive, and there were two hail storms. Fortunately, however, there was no damage done. This is a small township, and along Saskatchewan river there is a narrow strip of excellent land wooded with poplar. Farther from the river the soil is lighter, and was once well covered with jackpine. Much of this jackpine has been cut into cordwood, and forest fires have destroyed much, yet a considerable quantity remains. Deer are numerous. I saw no signs of minerals, but there are large deposits of building sand and brick clay, and a brick factory is in operation in section 22. The water is good all through the township; except in the vicinity of the river; the soil in this township is not suited to farming or stock raising. The grazing is poor. I think it serves a good purpose in growing timber.

I made a traverse of the north bank of the river through the township. This was a trying piece of work in the month of June. During that month the river was full and overflowing, so the shore could not be followed and almost the entire traverse had to be cut through the thickest and most luxurious growth of willow. This finished my work there and on July 14 I left for township 42, range 1, west of the third meridian, arriving there on the 17th.

The river lots in this latter township are mostly settled on by pioneers and stock raising is the principal industry. The other lots are settled on by immigrants and others who pursue real farming. With them I saw many wheat fields and later on good samples of grain. There is an abundance of timber for fuel and other purposes. The south branch of the Saskatchewan river traverses this township and west of the river the soil is quite sandy and the surface more rolling and open than east of the river. The banks of the river are very high and no lands are flooded.

There has recently been a new ferry put in operation near the northeast corner of section 18, which is known as Gabriel's crossing and a good road leads to Rosthern therefrom.

The same conditions apply to townships 43 and 44, range 1. Batoche is the centre of business for these two townships. The residents east of the river have access to the Canadian Northern railway ferries at Batoche and St. Laurent.

The last work to be done in the above townships was a traverse of South Saskatchewan river which was completed on December 28. On the following day I moved into Duck Lake settlement, stored the outfit for the winter and left for the east, arriving in Ottawa on January 4, 1909.

I have the honour to be, sir,
Your obedient servant,

GEO. McMILLAN, D.L.S.

APPENDIX No. 32.

REPORT OF C. F. MILES, D.L.S.

INSPECTION OF CONTRACTS AND RESURVEY IN SOUTHERN SASKATCHEWAN.

Toronto, March 1, 1909.

E. Deville. Esq., LL.D.,
Surveyor General,
Ottawa.

Sir,—I have the honour to submit the following general report on my operations in the field during the past season in southern Saskatchewan. The work consisted in part of restoration surveys of townships, inspection of subdivision contracts, and investigation and correction of disputed boundaries under instructions dated April 3, May 15, June 10, June 29, July 4, August 6, and October 10, 1908.

On April 11 I engaged a man in Toronto to proceed to Chaplin in order to collect my outfit, and to prepare my horses for the ensuing season's work. After feeding up the horses he hired a couple of men, to assist him in bringing the outfit to Craik on the Canadian Northern railway, a distance of about eighty miles, arriving there about April 25 where the whole outfit was overhauled, wagons painted, and harness repaired. I left Toronto on April 21, and after spending a couple of days in Winnipeg in order to collect my instruments and purchase some supplies, I arrived in Moosejaw on the 26th where I stayed over a day to interview some cooks who were offering their services.

I arrived in Craik on April 29, my senior assistant arriving on May 1. We started the following afternoon for township 23, range 1, west of the third meridian, arriving there on May 3.

It is well settled all along here and no more land is available for settlements. The soil consists of a black loam varying in depth from two to eight inches with a subsoil of about two-thirds of clay and the rest mostly sand, though in a few instances a gravel subsoil.

Restoration survey of this township was completed on May 18 and on the following day I broke camp and started with the outfit for Caron by way of Brownlee. I found there was no trail south through the hills from Caron so moved up to Telegraph trail near Moosejaw. After laying in some supplies at Moosejaw, oats for horses and wood for fuel, I started south on May 23, arriving in township 11, range 1, on the 25th where I traced a few lines and on the following day moved camp to section 5, township 10, range 28, west of the second meridian. Here I traversed the shores of parts of 'lake of the Rivers,' until the 29th when I moved camp back to township 9, range 1, west of the third meridian. I retraced some of the lines in this range down as far as township 6, taking observations, measuring angles and examining some corrections that had been made in the spring of 1908, in contract No. 13 of 1906. A number of new settlers had taken up homesteads in range 1, in townships 6, 7, 8 and 9 since last year. This section of country has much to commend it to the new settlers, save the want of fuel and scarcity of water; the latter difficulty, however, may be overcome to a great extent as soon as well boring appliances can be brought to work. Coal, although of an inferior quality, may be found in several places east of the 'lake of the Rivers.' The wood yet remaning in the northerly part of Wood mountains up as far as Twelve-mile lake is being rapidly diminished, and if it is desired that it be saved from entire

destruction, it will be found necessary to appoint a conservator for the purpose of preventing settlers from making heavy inroads into the green timbers and confining them strictly to using the dry and firekilled trees.

I broke camp again on June 8 and the outfit started for Moosejaw. Not being well myself, I drove in light and arrived there on the following day. On consulting a physician, I was advised to go to a hospital, my complaint being diagnosed as typhoid. My outfit arrived on the 10th and left on the following day for township 23, range 4, via Mortlach in charge of Mr. Stewart, my senior assistant, where they arrived on the 13th, passing through a well settled country which has been previously described.

While I was being treated at the Moosejaw hospital my party in charge of Mr. Stewart assisted by the junior assistant surveyed township 23, range 4, west of the third meridian. The new extension of the Canadian Pacific railway northwest from Moosejaw, traverses this township diagonally and the line was only partly graded at the time of the survey; since then the steel rails have been laid causing a considerable amount of traffic between its present terminals, Outlook and Moosejaw. The soil is rather light, nevertheless, most of the available homesteads have been applied for. A range of sand hills extends through parts of townships 23 and 24, ranges 3 and 4. These are covered mostly with scrub and brush, but in townships 23 and 24, range 3, there is yet a good deal of growing timber suitable for fuel and poles. Up to the present, settlers within a radius of nearly thirty miles have hauled their supply of fuel and poles from here, and it will be but a very short time until the supply is exhausted. It is not alone that the neighbouring settlers draw their own supply of fuel from these hills, but as I am creditably informed, there are some people who draw the wood into the towns situated along the line of railways, where they sell it. These settlers along the railways from Craik to Davidson on the Canadian Northern and from Eyebrow to Elbow on the Outlook branch of the Canadian Pacific railway, can draw their supply of fuel from these railways, as may also many of the settlers living within fifteen or twenty miles of these railways. In November and December last, while I was camped near these hills, dozens of teams daily were observed coming from the hills with large loads of wood. I believe it would be to the interest of the community at large to put a stop to this devastation by the appointment of a fire ranger or a forest ranger to watch that no more green wood be cut either for fuel or fencing purposes. We finished the restoration survey of township 23, range 4, on June 29, and from here moved camp to Chaplin and Ernfold; in the latter place we made some changes in the subdivision of the townsite and at the former place took additional measurements of angles and distances On July 8 I moved camp to Mortlach, the thermometer registering 98 degrees in the shade at noon, I laid in a supply of provisions and horse feed and started at sundown for the south to commence the inspection of subdivision contract surveys. On the 14th I reached section 10, township 9, range 6, west of the third meridian. Here we were overtaken by a heavy thunderstorm and camped. From Notukeu creek along the Gravelbourg trail the country is pretty well settled south to a range of hills in township 9; south of the hills there are but few settlers. My first camp on inspection work was on Pinto creek on section 13, township 8, range 8, west of the third meridian. The valley of the Pinto here is wide, but of little practical value, the soil consisting of a stiff white clay commonly called gumbo, and generally covered with sage brush.

Here for the first time I met with a bird I had not seen before anywhere in the territories, it is the sage hen and in size about as large as the domestic hen, but otherwise has the appearance of an ordinary grouse. In this contract, No. 1, consisting of twenty-four townships, I inspected sixteen townships and retraced about seventy miles. There were only about half a dozen settlers observed in this contract at the time of my examination; the land is somewhat hilly, though the soil is good and the prospects of an early settlement are promising. At the time of my inspection the

country was very dry, partly owing to the small snowfall during the preceding winter. The water in the creeks and rivers was not running but standing in pools, and the ponds with but few exceptions were dried up. July was a very hot month and at times the breeze, blowing over the prairie, felt like coming out of a hot oven, therefore, whenever I found it necessary to travel with the outfit, I made use of the very early morning or the late evening.

The inspection of contract No. 1 was completed on July 24 and on the following morning we broke up camp and started across country southeasterly for Wood river, where we arrived on the morning of the 26th and camped on section 7, township 6, range 6, west of the third meridian, in contract No. 13. This contract covers twenty-four townships out of which I inspected sixteen, retracing seventy-one miles and taking four observations for azimuth.

The southern portion of this contract is rather hilly and somewhat broken by ravines; it is traversed by creeks, containing pools of water and is more particularly adapted for grazing purposes. Wood river traverses this contract from south to north and at the time of my inspection was not running but contained water standing in pools. Most of the small creeks emptying into the river contained pools of water which was all more or less impregnated with alkali. The greater part of the contract is hilly and rolling prairie. No timber or brush of any description grows and settlers procure their supplies of fuel and fence posts from Wood mountains, southeast of this contract. Not many settlers improvements were observed south of the third base line, though quite a number of shacks and patches of plowing were seen to the north and east. Travelling through township 8, range 5, we saw a few antelope grazing in a dry slough.

On August 6 we broke camp and started with the outfit for the ford on Wood river; here I camped and repaired camp outfit, &c., that suffered much damage during a heavy storm on the night of August 1. We camped here waiting for the teams to return from Moosejaw with mail, provisions and horse feed, and on the 10th moved north past Gravelbourg post-office to the old Fort Walsh and Moosejaw trail. There is a bridge now across the Notukeu. We did not, however, cross the creek but followed the old trail westerly fording the creek in township 10, range 10, and entering the next contract, No. 9, on township 9, range 13. This contract comprises twenty-four townships and parts of townships. I examined seventeen townships and retraced eighty miles. The northeasterly portion of this contract is partly rolling and partly hilly; there are quite a few ponds among the hills and the land appeared well adapted for cattle raising. Numbers of range cattle and horses were observed. Frenchman river traverses eight townships of this contract; when full and running, it is from seventy to one hundred feet wide, but at the time of inspection the river was dry in many places, the water merely standing in pools. The immediate banks of the river are from ten to twenty feet high and precipitous. The valleys are wide and the prairie level, mostly two hundred to five hundred feet above the level of the river. There is a crossing of the river and easy access to the valley in township 5, range 16, another in township 3, range 13 and another in township 4, range 18. There is no timber but some brush grows along the banks of the river; wood for fuel and fencing however, may be procured from the easterly slope of the Cypress hills. A fairly good quality of coal is said to exist in township 7, range 19. No cultivation was observed in any of these townships that I examined. As far as I can judge the townships are well adapted for cattle and horse raising, but in the future when the railways projected become a fact, there will be a good field for settlers. The valley above the last mentioned crossing becomes somewhat cut up by ravines and is only accessible by the trail crossings above mentioned.

On the 22nd, one of my horses, a black gelding, succumbed to what experienced ranchmen pronounced 'alkali poisoning.'

I completed the examination of contract No. 9 on August 29 and moved up to the next one west, contract No. 3, the following day, travelling along the plateau north of the river by a good trail. We experienced a slight white frost on the morning of September 1 in the valley of the river. My camp previous to the last was on section 29, township 4, range 17, close to the winter camp of the 'T down' ranch (⊥). My first camp in contract No. 3 was on section 12, township 6, range 21, adjoining the home ranch of the same company. There is quite a wide valley, but it is eaten bare with all the cattle grazing here. There are twenty-eight townships and parts of townships in this contract, twelve being on and adjacent to Frenchman river, eight on Battle river and eight adjoining the fourth meridian. Of these I inspected sixteen, retracing fifty-one miles. From the home ranch of the 'T down' outfit, more or less irrigation work has been done up Frenchman river. We passed through the Z-X ranch, owned by Messrs. Enright and Strong, where they appeared to have excellent crops of wheat, barley and vegetables. I understood several hundred thousand dollars had been expended in irrigation. There are probably half a dozen settlers in this contract scattered along the river, all more or less engaged in cattle or horse ranching. On September 4 we broke camp and in order to reach the prairie level had to put four horses on the wagons to haul them out of the valley. On my way to Battle river portion of this contract I measured the east boundary of section 24, township 5, range 23, and found iron posts in witness mound marked correct. Frenchman river bounds the Cypress hills on the south side of the last two townships. The hills are about five hundred feet above the level of the river. There is some good spruce on the south bank of the river but it is being rapidly exhausted. At Battle river I retraced sixteen miles then moved on to Lodge creek on the fourth meridian; here I also retraced eight miles. There are a few settlers along these streams, but no cultivation to any extent was observed, the main industry being the raising of cattle and sheep; this section of the country is well adapted for that purpose. The most westerly contract examined was No. 8, being all in the province of Alberta. There were twenty-five townships in this contract, twenty-four of which were subdivided; here I retraced a few lines in thirteen townships. Four of these townships were subdivided by the late Mr. A. G. Stacey, who died at the Medicine Hat hospital shortly after his removal there. He was succeeded by Mr. A. Driscoll, who finished this contract. The work on this contract was found satisfactory and well up to the standard. There are probably ten or twelve settlers in the area comprising this contract who are engaged in cattle ranching. I was informed that on the west side of lake Pakowki, almost dry the past summer, there were some large herds of sheep. Owing to the drought during the past summer and scant snowfall the preceding winter, the country had a very dry appearance, the water in some of the lakes having disappeared altogether, one of these being Wildhorse lake in township 1, range 2, west of the fourth meridian along the international boundary. I finished inspection of these contracts on September 24, leaving the only one yet to be visited, No. 15, east of the third meridian. Owing to a long drive, about three hundred miles, back to this contract, the scarcity of fuel and water and the bad quality of the latter, I concluded to drive to Medicine Hat, load my outfit on a train and have it taken by train to Weyburn on the 'Soo' connection of the Canadian Pacific railway. Therefore on the morning of September 25, when during the previous night snow had fallen to a depth of about four inches, I broke camp and started for Medicine Hat. I succeeded here in obtaining a large car that took the whole outfit on the 29th. This car containing my outfit arrived at Weyburn on October 3. Laying in a fresh supply of provisions here I started on the 5th, passing through a well settled and almost level country. I reached contract No. 15 on the following day and camped on section 30, township 3, range 19, west of the second meridian, entering hilly country a few miles back. It was apparent by the growth of the grasses that this part of the country had been more favoured with rain than the part passed through lying west of the third meridian, the growth in places being almost

luxuriant. There were twenty-five townships in this contract, and I retraced lines in sixteen of these. Much of the area covered by this contract, more particularly east of Big Muddy creek is hilly. No settlers were found here except a few on the Big Muddy near the Royal Northwest Mounted Police post on section 9, township 1, range 22, west of the second meridian; they have cattle and horses. Hay appeared plentiful in the valley of the creek but from the price some of these settlers have the face to charge for beef, one would think that cattle were very scarce, and hay still more so. One of these men asked twelve and a half cents per pound for a quarter of beef he had just killed; that is the figure he is said to receive from the Royal Northwest Mounted Police authorities; however, I declined this liberal offer, having a couple of months previously purchased as good beef from another settler at seven and a half cents a pound, and at Weyburn butcher shops for eight cents per pound. While camped in this vicinity Corporal Edgerton brought some mail for me from Willowbunch, about fifty miles northwest. This being a quarantine station, there is a government veterinary surgeon stationed here, of whose presence I took advantage to have my horses' teeth filed, and also the breast of one of my mares treated where she had a running sore, caused by the injury received in transit on the Canadian Pacific railway. Our last camp in this contract was on a pond in township 3, west of the second meridian; here we experienced our second snowstorm this autumn and on the following day there was six inches of snow on the level. It happened that we got only the tail end of the storm, it being very much more severe about the Cypress hills, where several thousand sheep perished, also one or two men, and the railways between Medicine Hat and Swift Current were blocked for some days, whereas in this neighbourhood it was raining for a week more or less, with occasional snowfalls. There is still a quantity of poplar wood left, west of the Big Muddy though much of it is firekilled. The country too is considerably broken by ravines along townships 3, ranges 25 and 26. My outfit arrived at Willowbunch on the 18th where, owing to stormy and wet weather, they remained until Wednesday. I in the meantime started for Moosejaw in a light rig; my party arrived on the 24th, with horses very much played out on account of mud and heavy roads, and left again in charge of my assistant for township 23, range 3, west of the third meridian on the 26th, where they commenced the restoration survey of township 24, range 3, on October 29. With a small party, according to instructions, I left Moosejaw in the evening of the 26th for Estevan; here I engaged a conveyance to drive us to Dupuis postoffice in section 34 township 1, range 12, west of the second meridian, on the following morning, arriving there the same evening. Here I investigated the errors complained of in sections 29 and 32 by running a trial line north from the southeast corner of section 5, on the international boundary and along the east boundaries of sections 5, 8, 17, 20, 29 and 32, of which I returned sketch and field notes to the Department. The country from Estevan and Dupuis is well settled. Much of the grain raised about Dupuis is being marketed across the line where there are elevators within about five miles of the international boundary. I returned to Moosejaw on October 30 where we remained until the following Monday, the day the train left for the north which we took for Tugaske. From here we drove to camp on section 5, township 24, range 2, where my assistant was at work upon township 24, range 3. The greater part of this township is covered by sand hills, only about the two most northerly tiers of sections being available for farming purposes. There are some pretty fair feeding grounds among the hills which are covered to some extent by brush and some clumps of poplar, mostly second growth. Whatever of the latter is suitable for either fuel or fence poles is being rapidly removed by the settlers. The sand hills extend westerly into township 24 and partly into townships 23, ranges 3 and 4. On November 5 I left camp again with a small party for Tugaske, thence by rail to Brownlee, from there we drove on the following day to township 19, range 29, west of the second meridian, investigating errors said to have been made in the original survey. Here we re-measured the south boundary of this township and ran around sections 4 and 9 dividing these into equal

east and west halves, as requested by petition from settlers interested. The whole of this country is well settled and the grain raised is shipped by way of Mortlach and Caron on the main line, and by way of Brownlee and Keeler on the Outlook branch of the Canadian Pacific railway. It was storming most of the time I was engaged here. I returned to my main camp in township 24, range 3, west of the third meridian, on November 11. On the 13th the thermometer registered 10° below zero; I moved the whole camp to section 27 in township 23, range 2, where I purposed making a traverse survey of Eyebrow (Sandy) lake. The marshes to the southeast and northwest as well as the lake itself were frozen, so we found no difficulty in getting around it. We completed this traverse on the 16th and then moved camp to section 35, township 24, range 3, in order to be near a well at the school-house in section 2 in the adjoining township north. The school-house is a fine building for this part of the country and was put up at the cost of $1,000. Although the land is very light in the northern part of this township yet it appears to be all occupied and settlers thriving. I may mention here an instance where a family lately out from England are doing remarkably well. One of the sons arrived in Manitoba about six years ago with only two dollars in his pocket; he worked for a farmer and saved enough to send for his brother the following year; the two still working for wages succeeded in bringing out the rest of the family, mother and four children. The following season, and last year, owning five quarter sections between them, they had 3,400 bushels of wheat from which they realized about $2,700. These people, at home, had been working in a factory and living from hand to mouth, and now they are possessors of their land, homesteads, cattle, horses, pigs and poultry. I considered it a remarkable case of thrift.

Having ascertained that the trails south of Medicine Hat were again passable, a small party started in the morning for Craik thence via Regina to Medicine Hat. Here a conveyance was procured to make the trip south to contract No. 8, which could not be accepted on the first inspection owing to four townships not then having the monuments established. On this second inspection it was ascertained that everything had been completed and the pits dug out to requirements. On the 30th with the thermometer registering 15° below zero, the party returned from examining contract No. 8 in southeastern Alberta. The frost had now penetrated so deep into the ground that I decided not to dig any more pits after the resurvey of township 24, range 3 was completed. On December 5, with a small party, I started for Swift Current by way of Elbow and Moosejaw in order to investigate some alleged error in the original survey of section 24, township 18, range 14, west of the third meridian. On Monday morning I engaged a conveyance and drove out to Kneed Anderson's place. Measuring up along the east boundaries of sections 11 and 23 we discovered a gross error; here we also took an observation on Polaris and returning we arrived at Swift Current the same evening. I returned to Moosejaw the following evening and started for Eyebrow the next morning. From here I remeasured intersections of the section lines with the railway line (the Moosejaw to Outlook branch of the Canadian Pacific railway) and on the 12th left Eyebrow driving to township 23, range 2, where we camped, took an observation and also remeasured some of the section lines.

I completed the restoration survey of township 24, range 4, west of the third meridian on December 17 and on the 18th moved camp to township 23, range 2. On the 21st I started with a small party for township 19, range 29, west of the second meridian where I made some additional measurements. The following day I began to pay off some of my party and on the 24th moved my outfit from Tugaske to township 21, range 5, where the outfit was stored and horses wintered. From the time of my arrival in Moosejaw in the spring until my departure for home I travelled with my outfit about two thousand eight hundred miles. On December 26, I paid off the rest of my men and started for my home in Toronto.

I have the honour to be, sir,

Your obedient servant,

C. F. MILES, D.L.S.

SESSIONAL PAPER No. 25b

APPENDIX No. 33.

REPORT OF R. H. MONTGOMERY, D.L.S.

MISCELLANEOUS SURVEYS IN NORTHERN SASKATCHEWAN.

PRINCE ALBERT, April 21, 1909.

E. DEVILLE, Esq., LL.D.,
Surveyor General,
Ottawa.

SIR,—I have the honour to submit the following general report on surveys performed by me during January and February, 1909.

Under your instructions of November 24, 1908, I carried out a miscellaneous survey through northern Saskatchewan, driving by team a distance of about five hundred miles, covering only about sixty miles of this distance twice. Consequently considerable territory was covered. The temperature was severe at times; during the first two weeks it ranged between —30° and —40° Fahrenheit, dropping as low as —60°; at the same time a fair wind was generally blowing. During the remainder of the time it averaged about —10°. All kinds of trails were experienced, the worst being found between Meeting and Birch lakes, north of Battleford. Here we found trails which had not been broken this winter. Time and time again our horses could not force their way through drifts and we found it necessary to break for them. We carried no supplies except oats, depending entirely upon homesteaders for sustenance and were consequently vividly impressed whenever we came to a destitute settler, which was the rule rather than the exception, bread or bannock and tea being the standard diet. The farmers generally are thrifty, the stock as a rule being far better fed than the family.

We left Prince Albert on January 7, 1909, driving through a bush country which seemed to be only inhabited for the cordwood which is its chief industry. After passing Duck Lake settlement and turning westward, the aspect changed, the country opened up more and more and farming here is apparently carried on prosperously. On the way we passed through three Doukhobor villages; it was noted that little advancement had taken place in the general appearance of these since I was in that locality in 1904. They seemed rather to have deteriorated.

Arriving on January 11 at Redberry lake we proceeded with the survey as directed. The country surrounding the north end of the lake is settled by Galicians, who are making good farmers. They live in houses made of mud. The mixing of this mud is an art in which they excel. As a rule they are the cleanliest of our cosmopolitan population. Here they adhere to the Greek Catholic church and maintain the holidays of their motherland. These holidays seem to be numerous, three of them occurring during the twelve days that I was in that locality. January 14 they still observe as the new year. The longer they remain in this country, the less they adhere to their holidays. They report that both Blaine and Redberry lakes have a very bad odour in summer. The snow here averaged about one foot in depth. The country is rolling prairie and well adapted to farming. During January 21 and 22 a blizzard raged and on leaving Redberry lake on the 23rd we found all trails in the country obliterated. We travelled in a northwest direction through stony and hilly country fit only for ranching, which is being carried on here, until we arrived in

township 46, range 12. Here the land is well settled and the soil excellent for agricultural purposes. The least snow on the whole trip was found here, there being only about three inches on the level. The settlement extends to Meeting lake and consists of English, Irish and Scotch. From Meeting lake to Birch lake, the country is but sparsely settled, becoming more wooded and more difficult for clearing as one approaches Birch lake. The homesteaders here are in very poor condition to withstand the severe winter months. Their nearest point of supplies is Battleford and such is the condition of the trail that the settlers usually have to be on the point of starvation before undertaking the trip. The snow around Birch lake was eighteen inches on the level. On the shores of Birch lake we stopped at a homesteader's whose Scotch father had in the early days homesteaded in Manitoba and whose farm was six miles away from water. Being impressed with the lack of water, one settler has here homesteaded a quarter section consisting of fifty acres of land and one hundred and ten acres of water.

After accomplishing what surveys were necessary in this vicinity, we retraced our route to township 45, range 10, thence taking a more northerly route in order to obtain a better trail. We passed Muskeg lake and Marcelin on the way. All of this country is well settled and being farmed steadily. We arrived in Duck Lake on February 6. From here we continued in an easterly direction to Basin lake in township 42, range 24, west of the second meridian. The country is well settled by Mennonites, Galicians and German Catholics and is principally park country, farming being carried on prosperously. On the west side of Basin lake there is a colony of old country French, being by far the most destitute of all the settlers we encountered. From Basin lake a northwesterly direction was pursued to Fenton on the Canadian Northern railway. This country is level and well settled and covered with considerable woods except where it has been cleared. Mixed farming is being carried on. From Fenton to Prince Albert the country is rolling with scattered bluffs of poplar. Here is some of the best farm land seen on this trip, but farming is not carried on extensively as most of the land is owned by speculators. We arrived in Prince Albert on February 15.

I have the honour to be, sir,
Your obedient servant,

R. H. MONTGOMERY, D.L.S.

APPENDIX No. 34.

REPORT OF J. E. MORRIER, D.L.S.

SURVEY OF THE TOWNSITE OF FORT CHURCHILL.

MONTREAL, Que., February 26, 1909.

E. DEVILLE, Esq., LL.D.,
Surveyor General,
Ottawa.

SIR,—I have the honour, in accordance with my instructions dated May 26 and June 5, 1908, to make the following report on my surveys at Fort Churchill during the season of 1908.

I left Ottawa with my assistant on June 6, and proceeded to Winnipeg, where I was to take the canoes left there by Mr. Thibaudeau. After examining these carefully I found them unfit for my trip. I, therefore, purchased one Peterboro canoe 18-ft. x 42-in. x 18-in., and decided to rent another at Norway House. While in Winnipeg I met Commissioner Perry of the Royal Northwest Mounted Police, and I learned that arrangements had been made with the Hudson's Bay company to transport the Churchill patrol from York Factory to Fort Churchill in their coast boat 'Strathcona,' which was expected to leave York on July 15. Mr. Perry advised me to procure some provisions, as he was unable to say what they had at Churchill. After several interviews with Mr. Chipman, commissioner of the Hudson's Bay company, he finally agreed to take three more passengers on board the *Strathcona*.

I, therefore, bought some provisions and left on June 12 via Selkirk for Norway House, where I was compelled to remain five days. While there I made a few magnetic observations. On the 22nd I left Norway House for York Factory with canoes and Indian guides, following the Echimamish and Hayes rivers, arriving at York Factory July 5. On the way down I had stopped at Oxford House to make some magnetic observations.

Owing to floating ice along the coast the *Strathcona* did not reach York until the 17th. She was leaking so badly that she had to be beached for repairs. We finally left York on the 23rd, and landed at Fort Churchill on the morning of the 25th, having been favoured by a good breeze.

On the 27th we set up camp on the east side of the river, and began the survey according to instructions.

Progress in our work was rather slow owing to high winds and rain which fell nearly every day. This drawback, coupled with the fact that the native help proved to be absolutely useless, was most aggravating and compelled me to give up the digging of pits at block corners, and to make them at section corners only.

The northern part of the eastern peninsula was blocked out as far south as 17th avenue, the remainder was laid out in sections only.

The season being far advanced I did not subdivide any of the blocks into town lots.

On September 16, we moved our camp to the western peninsula and proceeded with the survey, but on October 3 two of my labourers, hired in Churchill, and with whom I had no contract, quit work to return to their shack on the east side of the river. Consequently from that date little was accomplished, as it is almost an impos-

sibility for only three men to carry on surveying operations. On November 1, having no more firewood, we were compelled to strike camp and move on to the barracks, where we remained until our departure.

I regret to say that I was unable to examine the location of the water-power applied for by Mr. Wm. Beech.

At Churchill the surface is mostly bare and rocky, with clay and boulders in the river flats. A ridge of greenish gray sandstone or quartzite extends to the coast on each side of Churchill river, and on the eastern side stretches eastward along the coast several miles. These ridges consist of a succession of rounded hills, attaining a maximum altitude of one hundred and twenty feet on the western peniusula. On this peninsula the ridge is broken by a marshy gully covered with small spruce and tamarack averaging three inches in diameter. This gully is locally known as 'sea horse gully.' A low, gravelly point extending seaward from the hills forms the western bank of the river immediately at its mouth. On this point lie the ruins of Fort Prince of Wales.

Timber on the eastern peninsula begins at 37th avenue, and consists of small spruce with a few scattered tamarack, averaging four inches in diameter, but farther up the river, along the banks and on the islands some good sized spruce may be found, though not in sufficient quantity for commercial purposes. On the western peninsula, spruce suitable for fuel may be found about two miles southwest of the Hudson's Bay Company's post.

Scales of specular iron were found on both peninsulas. This was the only mineral observed. Good building stone may be found almost anywhere in Churchill; there is also a large deposit of cream coloured limestone along the coast, between 24th and 26th avenue, on the eastern peninsula.

In the neighbourhood of Fort Churchill it would be difficult to grow grain of any kind, owing to the short season, which barely commences in July, and then heavy frosts setting in in September make the summer season only ten weeks. However, vegetables may, on exceptionally good years, have time to mature.

Around Button bay and in the river flats, a good quality of hay grows in abundance to permit the raising of horses and cattle.

There are a few lakes of fresh water on the eastern peninsula, which ought, for a few years, to accommodate a small population, but later on, water could be brought from several large lakes about six miles south of 37th avenue, and the smaller lakes referred to above, could be used as reservoirs. On exceptionally high tide, the flats are liable to be partly flooded.

At Mosquito point, about nine miles from the mouth of the river, there is a small rapid, but it is doubtful if any water-power could be developed owing to the low shore of the river at that point.

Game is plentiful, consisting chiefly of geese, white swans and several varieties of duck. Ptarmigan and partridge are abundant all along Churchill river. Caribou this year were not so numerous as in former years; however, large herds were reported by the Indians and Esquimaux. Polar bears, wolves and Arctic hares are occasionally shot, while ermine, mink, otter and foxes of all varieties, but particularly white foxes, are trapped around Churchill. Numbers of seal of several species frequent the mouth of Churchill river and Button bay, attracted by the abundance of fish at these places. Every spring the Esquimaux congregate along the western peninsula for the purpose of seal hunting. During July, August and September the porpoise or white whale is very common; they can be seen going up the river at every tide in large shoals. Salmon, trout and whitefish of excellent quality are found in the river all the year, but are more abundant in July and part of August.

The land covered by blocks 102 to 108 should be reserved for a park. This is a nice sandy plateau overlooking the sea and the only suitable place for a park in the northerly part of the townsite. In the southerly part, the following blocks should also be reserved for a park:—427 to 431, 467 to 471, 498 to 502, 541 to 545 and 572 to 576.

The rocky point of the eastern peninsula should be reserved for a lighthouse or signal station. Beacon island could serve a similar purpose, or be used for a wireless station.

The fine but rather small harbour of Churchill lies immediately within the mouth of the river. The entrance is about half a mile wide and is regarded as quite safe. There are a couple of reefs in the mouth of the harbour and if they were removed it would widen the entrance considerably. The harbour is well protected from the north-west by the projecting point of the western peninsula and Beacon island, so that in entering vessels have to describe a curve, but they immediately get away from the influence of the ocean waves, and once inside they are in perfect shelter. The basin, which fills up with every tide, is about nine miles long and averages two miles in width at spring tide. This large volume of water having to pass out of the narrow entrance when the tide goes out, causes a very strong current from the basin. The spring tide is sixteen feet and the neap tide about nine feet. The channel retains the same width at neap and spring tide. Deep water does not extend very far and in the present state of the harbour vessels could go only about one mile inside the mouth of the river, where there is sufficient space to anchor seven or eight ships. However, judging from the nature of the river bed, which appears to be sand and gravel with boulders, a good and large harbour could be made with comparatively little trouble or cost. No difficulty would be encountered in building elevators, wharfs and warehouses along the shore of the eastern peninsula.

According to the information supplied by Major Moodie and the office of the Hudson's Bay Company's post, the average date of opening of the harbour is June 15, but for some time before it closes, which is generally about November 15, it would not be safe for ordinary vessels to venture in, owing to the rush of floating ice in the current. The entrance is also apt to be crowded with ice in the spring, as was the case last season.

We left Churchill with Major Moodie and the police patrol on November 21, and arrived at Split lake on the evening of December 6; at this place we were detained four days, owing to the scarcity of dogs. On the 11th we left Split lake and reached Norway House on the 22nd, having covered the whole distance from Churchill to Norway House (567 miles by winter route) on snowshoes in twenty-eight days, walking an average of twenty miles a day. On my arrival at Norway House I made arrangements for transportation to Gimli, but it was impossible to get Indians to leave the post before Christmas. We therefore left on the 26th, and arrived in Winnipeg, via Gimli, on January 6, 1909. I settled my accounts and left on the 8th, arriving in Ottawa on the 10th.

During my trip to Churchill I was placed under many obligations to Superintendent Moodie of the Royal Northwest Mounted Police, and to a number of officers of the Hudson's Bay company, to whom my cordial thanks are hereby extended.

In conclusion, I wish to express my appreciation of the valuable services of Mr. F. H. Peters, who was appointed as assistant.

I have the honour to be, sir,
Your obedient servant,

J. E. MORRIER, D.L.S.

APPENDIX No. 35.

REPORT OF T. H. PLUNKETT, D.L.S.

SURVEYS IN THE EASTERN PORTION OF THE RAILWAY BELT.

MEAFORD, January 18, 1909.

E. DEVILLE, Esq., LL.D.,
Surveyor General,
Ottawa.

SIR,—In accordance with your instructions dated April 11, 1908, I left Toronto on Saturday, April 25, and reached Kamloops on Wednesday, April 29.

Here I met Messrs. J. E. Ross, D.L.S., and E. W. Robinson, D.L.S., and with them arranged a division of the season's work, by which I took all surveys required west of the fifth meridian, and, having organized my party, we left by the Canadian Pacific railway for Golden, B.C., on May 6. On arriving there I commenced the subdivision into town lots of the undivided blocks of the townsite of Golden.

The town of Golden is most favourably situated being on the main line of the Canadian Pacific railway, and is the northern terminus of the proposed Kootenay Central railway now under construction. No doubt, in a short time this town will become an important railway centre and distributing point for the Columbia valley, extending up to the well known Windermere district, where fruit farming is beginning to occupy the attention of incoming settlers. Fuel, including wood and coal, are easily available, the former from the surrounding country which is well wooded with spruce, birch, and pine, and the latter over the Canadian Pacific railway.

In Hospital creek, Golden has an abundant supply of good water within half a mile of the town. Excellent water-powers can also be easily developed on this creek for manufacturing purposes.

At Golden, the Columbia River Lumber company have a large and up-to-date sawmill. The supply of merchantable timber in this vicinity is very large and lumbering continues to be, as yet, the chief occupation of the residents.

After completing surveys in the townsite I was engaged, during June and part of July, in smaller surveys along Columbia river for a distance of ten miles above and below Golden. A first class wagon road along the river renders travel easy from one locality to another.

The land in the valley consists chiefly of rich black loam and what clearings have been made, show the land to be well adapted to mixed farming. All kinds of vegetables are raised successfully and small fruits of the strawberry and currant varieties, yield abundantly. Fruit farming of the apple and plum varieties may be said to be in its infancy. There is, however, at present great activity in this branch of farming. There is no doubt, I think, that the bench lands along the river are well adapted for raising plums and particularly apples. The near future will no doubt see great development in this line. This land is well suited for fruit lands, it being for the most part clay loam with gravel subsoil. This soil in most places is not as rich as might be desired, but with intelligent handling it could, I think, be made very productive. If the present activity in fruit farming continues, no doubt in a short time the settler will have, to aid him, expert knowledge of how best to handle this kind of land, with a view to its betterment.

These lands are wooded with small spruce and poplar, and can be easily cleared. The land is fairly level and can be easily worked. Summer frosts occur in this locality but the apples being raised at present in the valley, though to a small extent yet, show that the frosts are not severe enough to do much damage.

During the season of 1908 the rainfall was sufficient for all branches of farming. Should irrigation become necessary on the bench lands abundant water is easily obtainable from the numerous mountain streams in almost every locality.

The vicinity of Golden has been until quite recently the scene of mining operations to a limited extent. Gold, copper and mica claims are to be found in this locality. These for the most part are undeveloped. In common with other mining districts there has been a decided falling off in the past year or two in this line. Want of capital for development work is the great draw-back; but the probability is that there will in the near future be activity in at least the mica mining.

After completing the surveys around Golden, we left in the early part of July for Albert Canyon station, where I made a small survey. In this neighbourhood there is some fine cedar, spruce, hemlock, and fir timber. The cedars are very large, from four to six feet in diameter. The soil here is a very rich black loam from twelve to sixteen inches. The area of available farming land is limited and the cost of clearing the land would be from one hundred to one hundred and fifty dollars per acre. The future of this locality depends upon its development as a mining and lumbering district. There are, in this neighbourhood, some very fair prospects of gold and copper but at present mining is not active.

The entire absence of mosquitoes at this place, which I believe is characteristic, the beautiful mountain, and river scenery, and a fine hot spring close to the station would render it an ideal summer resort.

From here we moved to Revelstoke and after a small survey left for the valley of the Incomappleux or as it is known in the district "Fish river." We reached this locality by the Canadian Pacific railway from Revelstoke to Arrow Head, Bowman Lumber Company's passenger boat to Beaton, and thence by stage to Camborne. There is a wagon road from Camborne up the west side of the river and a pony trail on the east. From Beaton to Camborne is a very good Government road, but from Camborne north the road is very rough over which the Cartage company at Camborne hesitated to send wagons.

Our first work here was the survey of timber berth No. 528, block VI., in township 22, range 27, west of the fifth meridian. The progress made here was very slow, as I was compelled to keep the camp in the valley and we had to climb up to our work, a great deal of which was from 2,000 to 3,000 feet above the valley.

The valley of Incomappleux river, north of Camborne, is from three-quarters of a mile to a mile wide. In the valley and on the first benches there is an abundance of fine timber. On the west side of the river the timber consists chiefly of very large cedar, with some fir and hemlock. The cedar in the valley is mostly hollow, there remaining an outer rim of from one to two feet of sound timber. On the bench on the west side of the river the cedars are mostly sound, and range from four to six feet in diameter. The fir and hemlock are also very large and sound.

On the east side of the river there is a narrow strip of cottonwood and poplar, but after this the cedar, hemlock and fir are of the same size and quality as on the west. The timber extends on this side up the mountain a short distance, when it becomes smaller. There are no benches on this side except around Boyd creek, and the mountains rise rapidly to a high elevation.

The valley slopes and benches are very thickly wooded and resemble the woods around Albert canyon, though the undergrowth at the latter place is very much heavier.

The land in the valley consists of a rich, black loam well suited for farming, but the cost of clearing the land, which would range from one hundred to one hundred and fifty dollars per acre, will, no doubt, prevent much development as a farming section.

There is an abundance of spring water in the valley, but on the slopes to the northwest there is absolutely no water, which circumstance rendered our work in the hot weather very trying. The climate is well suited for farming, as no summer frosts occur.

The future of this locality will depend upon its development as a lumbering and mining district.

Good water-powers are available on Sable, Lexington and Boyd creeks, and Incomappleux river is well suited during high water for driving logs to the Arrow lakes. On the mountain sides there are numerous claims of free gold and silver-galena ores. Some of these claims, including the Oyster, Criterion, the Silver Dollar and the Eva, have developed into working mines.

The gold ores are free milling, and the gold being finely divided can be treated by the cyanide process. With the introduction of this process, there will no doubt be renewed activity in gold mining, but the cost of handling smelting ores is too great in this district at present to permit of development. A railroad through this district to the Arrow lakes would develop the mining industry in this section very rapidly.

Goats are plentiful on the mountain side, and some mountain trout are to be found in the river and in flowing creeks. Bears, lynx, weasels, minks and occasionally martens are to be found in the valley.

After completing this survey, I commenced at the northeast corner of section 34, township 21, range 27, to work on the limit of the railway belt. We were unable to use pack ponies, and our progress was rendered very slow.

First class timber, including cedar, fir and hemlock, was found in section 34 and the eastern part of section 28, township 21, range 27, but after this the elevation rendered the growth stunted and small.

The country towards the summit was very rough, and in places water was very scarce, necessitating long walks to our work and great difficulty in man-packing our outfit.

Merchantable timber was not again encountered until, having crossed the summit, we reached sections 19 and 20, in township 21, range 27, where only the southern portions were wooded. The country, until reaching here, was covered with thick brush and ground cedar and hemlock.

Sections 13, 14, 10 and 9, in township 21, range 28, were well wooded with cedar, fir, spruce and hemlock from two to four feet in diameter.

In section 9 our line began to rise again above the timber, and snow on Mount Sproat, the summit of which we had to cross, prevented further work this season.

Game, including goats, bears, deer and caribou, are to be found in this district. The land, on account of its elevation, is useless for agriculture.

The weather during the latter part of our work was very wet, snow and rain almost every day rendering progress slow.

After abandoning this work and completing some work near Golden, rendered impossible during the hot weather by high water on the rivers, I commenced some surveys of timber berths in township 20, range 1, west of the sixth meridian, in the valley of Cranberry creek.

This locality was reached from Revelstoke by taking the Canadian Pacific railway as far south towards Arrow Head as the twenty-fourth mile-post and here crossing the Columbia to a wagon road on the west side. On this road we were able to get as far as the north boundary of township 20, range 1, on Cranberry creek.

Townships 20 and 21, range 1, are thickly wooded with cedar, fir, spruce and hemlock ranging from three to four feet in diameter in the southern portions of township 20 to two feet in township 21. The bush is clean and the timber sound. Cranberry creek is suitable for driving logs, and this timber can be handled and delivered to mills on the Arrow lakes at a very small expense, about probably six to eight dollars per thousand.

The soil in some places along Cranberry creek is suitable for farming, but for the most part the soil is too sandy. Nearer the Columbia first class farming land is to be had which can be more easily cleared.

The climate permits of all kinds of farming operations.

This closed my season's work, and we proceeded to Kamloops, where my outfit was stored for the winter.

I have the honour to be, sir,
Your obedient servant,

THOMAS H. PLUNKETT, D.L.S.

APPENDIX No. 36.

REPORT OF A. W. PONTON, D.L.S.

SURVEY OF THE FIFTH MERIDIAN FROM TOWNSHIP 77 TO TOWNSHIP 107.

MACLEOD, ALBERTA February 5, 1909.

E. DEVILLE, Esq., LL.D.,
Surveyor General,
Ottawa.

SIR,—I have the honour to submit the following report on the survey of the fifth meridian, between townships 77 and 107, inclusive, in the Athabaska district, in accordance with your instructions of February 21, 1907.

Transportation being the main difficulty, I had your permission to visit Edmonton before starting on the survey, to make enquiries from the Hudson's Bay company and other fur traders carrying on business in the district, as to the best means of access, provisioning a party, &c. I therefore remained in Edmonton from February 11 to 28, and obtained all the information possible. Supplies were ordered at the same time and arrangements made for their shipment. A part were to be sent to Moose portage on Athabaska river, near where it is crossed by the meridian, and the larger part to Wabiskaw lake, fifty miles farther north. It was essential that supplies should be taken to Wabiskaw by way of the winter road, which had just been completed by the Alberta government, as the summer water route, by way of the Athabaska and Pelican rivers, is not favourable to transportation, owing to low water in the latter river. The weather during February had become milder, snow was fast disappearing, and freighters hesitated to undertake the trip, but the return of severe cold and snow at the end of the month removed the difficulty, and supplies were at length shipped.

As pack horses were to be required, enquiries were made in every direction in the vicinity of Edmonton, but it was soon found that the Grand Trunk Pacific survey parties had swept the country clean, and that I would have to look elsewhere. The horses were eventually obtained at Cardston and I may here mention that they proved satisfactory, being gentle and well broken.

The winter of 1906-7 will long be remembered for its severity and length. It was so protracted that it was well on in June before grass was available for horses. Actual start in the survey was consequently deferred until then, or six weeks later than in ordinary years.

My party left Edmonton on June 20 for Athabaska Landing. On my arrival at that point I learned that the trail I had proposed taking had been obstructed by forest fires between Baptiste lake and Moose portage. I therefore decided to send the horses light, in charge of a half-breed guide, to save chopping out a new road, and to take my party to Moose portage by steamer. The river was in flood at this time, which would, in any case, have made it necessary to await the steamer at Moose portage to cross the horses over to the north side. By July 5 the party, pack horses and camp equipment were on hand at Moose portage for a start into the wilderness of bush, swamp and mountain. I expected to pick up Mr. H. W. Selby's trail where the meridian crosses Moose lake, and to follow it to the northeast corner of township 76, as far as he had run the meridian, which was my starting point, but in this I was disappointed. His trail had evidently been cut out during a dry season, and

proved for the most part impassable during the wet season with which I had to contend. It was found necessary, therefore to cut out a new trail around the south shore of Moose lake and north along the meridian to my starting point, a distance of approximately forty miles. This proved an arduous task, owing to the swampy nature of the country lying south of the Pelican mountains. It had been rendered almost impassable for pack horses by heavy rainfall, and as they were unaccustomed to the work at this time, they would become mired when crossing soft ground, which they eventually learned to cross without difficulty.

Our starting point was reached on July 24. Work was commenced on the 25th and continued until August 2, when it became apparent that I had underestimated the quantity of supplies required to reach Wabiskaw, my main base, so I decided to return at once to Athabaska Landing and procure what was necessary. I had also at this date gained sufficient knowledge of the country to convince me that native labour would be of more value than that of several members of my party, who showed little courage to face the insect pests, which were indeed abnormal, or the wet conditions and other hardships incident to a survey in this district. My cook had also proved a failure, and I decided to discharge all unsatisfactory members of my party and take them back to Athabaska Landing. A start was made on the afternoon of August 2 and the Landing was reached on the 5th. Supplies were at once purchased from the Hudson's Bay company, and arrangements made for their shipment to Moose portage by steamer on its arrival from Grand rapids. I then proceeded to Edmonton to procure a better cook and a reliable head chainman. In this connection I may quote Mr. R. W. Cautley, in his report for 1906-7. 'The universal prosperity of this district during the past year and the great activity in railroad construction, building, farming and lumbering have resulted in creating an unlimited, and therefore unsatisfied demand for labour and horses, which has raised the wages of one and the price of the other to an unprecedented extent, so that it is not remarkable that the men who presented themselves for survey work should have been small in number and not up to the standard in former years.' These were the conditions I had found in June and they were now accentuated; no men were available except at their own terms, and a few days were necessarily lost before they could be secured. Returning to Athabaska Landing, I found it necessary to borrow two canoes from the Mounted Police to enable me to reach Moose portage where pack horses were waiting, and my camp was reached on the 27th. Work was resumed on August 28, and from that date until December 12, was carried on with great regularity, seventy miles being completed. I was now over fifty miles from my base of supplies at Wabiskaw, and the snow had become so deep that little feed was available for horses and their use could not be continued. Also by this date my surveying instruments required certain repairs. The six-inch Stanley transit (1906 pattern) in particular, needed specific attention to fit it for continuing the work. I decided therefore to pay off the native members of my party, and to employ the remainder, or white men, in cutting out a road ahead of the line to Wabiskaw river, and as far beyond as possible, bringing up all supplies and building substantial caches, while I would return to Edmonton with instruments needing repairs, and would ship in such further supplies as would be required to carry the line through to Peace river. This plan was carried out. I was detained at Edmonton much longer than I had anticipated, awaiting the return of my instruments, and when returning from Edmonton to Wabiskaw, between February 19 and March 6, I was laid up at Calling lake with pleurisy. Although not able to obtain any attention whatever during this painful illness, fortunately no complications occurred, and I was able on March 5 to go on to Wabiskaw, and later to my camp. I found on my return to my party, that no time had been lost. It had been found feasible to harness the largest of the pack horses as a four horse team and to haul from thirty to forty hundred pounds at a load, following the ice by way of Wabiskaw river to a point where the trail, cut out approximately in line with the meridian, intersected the river. Here

a building had been prepared, sufficiently strong to resist any attempt of bears or wolverines to enter it, and at this point the cook made his headquarters, supplying the teamsters and the men cutting the road, with bread as they needed it. The distance by river and lake between this point and Wabiskaw was at least one hundred and fifty miles, and five trips, occupying ten days each, were required to bring on all supplies for the party and pressed hay and oats for the horses. My packer, who did the teaming, had to undergo much hardship, as he camped out wherever night found him, and he did this on fifty nights. From this cache on Wabiskaw river a trail was cut out thirty miles farther north to Burnt lake, where three Indian families live, and where I was able to lease a small house as a cache. This trail crossed a tract of brulé and windfall, and much chopping was required to make even a dog trail. Burnt lake lies in a chain of hills which seems to be a continuation westward of the Birch mountains, and on these hills snow fell to a depth of three feet, and much deeper in the hollows. In this region it was found impossible to use horses except with flat sleighs they were therefore harnessed to sleighs which had been provided, and two teams of dogs were also employed taking supplies in to Burnt lake. This routine, while apparently very easy and simple on paper, entailed much labour and hardship.

Between March 6 and April 5, all supplies had been distributed between Wabiskaw river and the Burnt lake cache, and on April 6 and 7, camp was moved to Corn lake, a few miles ahead of where the meridian had been left in December, viz. township 87. Work on the line was commenced again on April 8 and continued from day to day until Panny river was reached in township 96 on May 30, and another fifty miles had been added to the meridian.

At this date I received word that the *Stanley* transit was at Pelican portage, and the Hudson's Bay agent at Wabiskaw would not assume the responsibility of forwarding it to me through the hands of the Indians. As I was again getting too far from my base of supplies, I decided to go after the transit myself, while my assistant explored for a trail ahead to the Red river and moved on all supplies. On June 1 I left the camp for Wabiskaw, taking two Indians to do the canoeing up Wabiskaw river and from Wabiskaw lake to Pelican portage and return. One of my canoes had been left at Chipewyan portage during the winter, in anticipation of its being required. From my camp to this portage occupied three days, from the portage to Wabiskaw three and a half days. I remained two days at Wabiskaw preparing my mail, including progress report. Three days and a half were required to reach Pelican portage, where I arrived on the 13th. The 14th, being Sunday, I allowed my canoemen a much needed rest, and on the 15th I started the return journey with the transit in my charge. Wabiskaw was reached on the 18th, but owing to a constant downpour of rain it was impossible to proceed until the 22nd. Wabiskaw river being now in flood, fast time was made back to Chipewyan portage, and my camp was found at Burnt lake, on the 27th.

During my absence, a trail had been cut through to the main Red river and all supplies moved up and stored in a well constructed building with spruce bark roof. The pack horses, however, I found in very poor condition from the attacks of mosquitoes and bulldog flies. My assistant had found it necessary to retreat to Burnt lake, where there was open feeding ground, after one horse had been actually killed by mosquito bites. The mosquitoes would rise out of the moss in black clouds and prevent the horses feeding at any time, night or day. There now appeared a slight lull in the storm of insects and a move was immediately made to the end of the meridian in township 96. Work was recommenced and continued without further interruption until the northeast corner of section 25, in township 107, was reached on October 21, at Manuche lake, which is within easy touch of the Hudson's Bay company's post at the confluence of the Red and Peace rivers.

Although my instructions were to carry the line to Peace river, it was now so late in the season that I knew that unless I brought my party out before the advent

of deep snow, it would not be possible for us to come at all, chiefly on account of want of feed for the horses and we would practically become prisoners for the winter. Even if work could have been continued, our supplies were nearly exhausted and the Hudson's Bay company's posts along Peace river do not carry more than sufficient for their own needs. I was also influenced by the fact that the mounding between townships 88 and 96 had been omitted during the spring months, because of frozen ground, and I wished to complete it before the cold again set in. I therefore decided at this date to turn back, and my party was divided, my assistant taking the greater number of the men to do the mounding, while I remained behind with a few men, to observe for latitude. On November 14, the party was reassembled at the Hudson's Bay company's post at Wabiskaw. The horses were now harnessed to our sleighs and the winter road, by way of Calling lake, followed to Athabaska Landing. Poor sleighing and the need of horse shoes caused some delay, but the Landing was reached without mishap on the 24th, and my party paid off at Edmonton on the 30th. I returned to my home at Macleod on December 3.

Following is a description of the country between the Athabaska and Peace rivers, along the line of the 5th meridian, also of all matters observed in connection with climate, minerals, water, water-power, stone quarries, fish, animals and game:—

Between Moose portage on the Athabaska river and Moose lake occurs a strip of good land eight miles wide, suitable for settlement. This is bush country, as is all the country between the Athabaska and Peace rivers. Moose lake is one mile wide and fifteen miles long and whitefish are plentiful in its waters. Between Moose lake and Pelican mountain, a distance of fifteen miles, a flat tract of country extends east and west. At least fifty per cent of the whole area appears to be swamp land and drainage will be required to make it available for settlement. Pelican mountain is a continuation eastward of Martin mountain, and it is the watershed which separates the water flowing to Athabaska river on the south, and Peace river on the north. This so called mountain has no very prominent or rugged features and is composed of boulder clay, although boulders are little in evidence on the surface. The mountain is not worthless as it will eventually prove excellent for pastural purposes. This elevation, however, presents serious obstruction to railway construction making the country to the north of it inaccessible, but a pass, or depression, cuts right through the hills immediately west of the meridian, which might be utilized. Excellent spruce timber formerly covered these hills, but fire has swept off quite ninety per cent of it; patches of good milling timber, however, still remain, and will furnish logs for portable mills for many years. The northern slope of Pelican mountain extends twelve miles, and being very gradual, conditions are favourable for agriculture. A southern exposure has generally been regarded as most favourable to the growth of plant life, but a preference for a northern exposure is now quite common in the western prairie provinces. The soil is chiefly loam, and the timber mixed. Willow river, crossing the north part of township 78, drains the north slope of Martin and Pelican mountains. It is a stream sixty feet wide and one foot deep at low water, and it is easily fordable, as the bottom is usually hard yellow sand. A strip of good land follows this river to Wabiskaw lake for a width of half a mile on either bank. After crossing the river, spruce swamp extends through township 79. Higher land lying west of Wabiskaw lake is then reached, where conditions suitable for agriculture are again found. I may here mention that the country surrounding Wabiskaw lake is immediately suitable for agriculture, although I cannot report how far back from the lake, but I would estimate an average of one mile. The soil throughout all this country is drift clay. The varieties of soil included under the term 'drift,' as far as compositions and properties are concerned, are innumerable, so I will only here state that I would judge the soil to contain from thirty to sixty per cent of sand, the smaller percentage giving clay loam and the greater loam, and these soils were found to merge from one into the other. Sandy loam seems to exist along the banks of streams such as Willow

river only; gravel and boulders are little in evidence on the surface. This country can be considered as particularly favourable for the class of settlers who have little or no capital to invest, other than their own labour, and at the same time offers attractions to many of all classes who never become reconciled to the great lone prairies. To the poor man the fish in the lakes and the moose in the woods will remove all fear of starvation; the forest will provide fuel, and when the forests have disappeared, coal will be available, lignite coal of good quality having been observed in township 78. The extensive swamp areas lying between Athabaska river and Wabiskaw lake make access to the latter point unfavourable during the summer months. These swamp lands exist owing to the lack of natural drainage or to the obstruction of the natural drainage lines, as moss, &c. I am inclined to favour the latter view. A feasible settlement road might be located from the Government road at the junction of Lesser Slave and Athabaska rivers to the west end of Moose lake, following the north shore of Moose lake to the fifth meridian, then swinging in a semicircle through northeast, north and northwest, until the meridian was again crossed at the foot of Pelican mountains, and across the mountains by way of the pass already referred to to the banks of Willow creek, and then following Willow creek to Wabiskaw lake. Such road would not only give access to Wabiskaw lake country, but would open up many good areas along its whole length. Wabiskaw lake, so far referred to, is the western of the two lakes of the name. Between these two lakes a large area of good hay land occurs, and following the chain of waters which forms the canoe route eastward to Pelican rapids on the Athabaska areas of meadow land are available on a large scale. Hay is an abundant crop throughout the country and is found along all creeks at points where beaver ponds have become meadows and around lakes lying west of Wabiskaw lake. Peavine is also common throughout the poplar bush land. From township 78 to township 82 my field notes show forty-four per cent as swamp land and not immediately available for settlement. It cannot be regarded as worthless, however, and defining it as muskeg, as is usual, is unfortunate, and will be referred to again. From township 83 to township 90 my field notes show twenty-five per cent as swamp land. The soil is of the same character as that in the Wabiskaw lake district, varying between loam and clay loam, but the country becomes more undulating and rolling. Townships 88 and 89 are apparently a continuation of Trout mountain, and I would not be surprised to learn that this elevation extends eastward to Grand rapids on the Athabaska, and if so, a trail or road could be constructed giving a short connection between Athabaska and Peace rivers. Forest fires have swept through all this country, and the large timber which formerly flourished has disappeared, with the exception of isolated clumps. The present condition of brulé and windfall give an appearance of great desolation, but comparatively little labour would be required to clear the land. In its present desolate condition it is the natural habitation of moose. Immediately along the banks of Wabiskaw river good soil prevails and very attractive locations for farms could be found along its whole length. Unfortunately this stream is not navigable for anything larger than a canoe, and the numerous rapids greatly impede travel even with a canoe. A road could easily be constructed along it. In township 81 Wabiskaw river is crossed. The valley has now become seventy-five feet deep and the pleasant lower banks of the upper stream have disappeared. From this river to township 92 the country is generally level, rising very gently towards the north; my notes show thirty-six per cent swamp for twelve miles. The soil is here more sandy than that met with farther south, but it is by no means barren. Much brulé and windfall is also widely distributed. With township 93 the country rises by successive steps and becomes hilly and appears to be a western extension of Birch mountain. Large areas have been almost entirely cleared by fire, and grass of the wild grain varieties, chiefly blue-joint, has taken root, and as it cures standing, affords considerable winter feed for cattle or horses. Lying one mile east of the meridian in township 95 is Burnt lake, which is the largest of a group of

five lakes lying close together in the hills. A few Indians reside here, but no more are met with until the Peace river country is reached. Panny river, which is crossed in township 96, drains the northern slope of the Burnt lake country and is a tributary of Wabiskaw river. It occupies a valley one hundred feet deep and a mile and a quarter wide. From township 98 to township 101, a distance of twenty-four miles, the country is drained by Red river and its tributaries. This country can fairly be described as low and swampy and unfit at present for agriculture. The swamps are not muskegs, however, and clay is found under the moss. The field-notes show thirty-five per cent swamp and this percentage appears low. The meridian appears in this case to follow a series of ridges and a fair average cannot be obtained from the notes. Some particularly fine spruce follows the three branches of Red river, and these streams are suitable for conveying logs to Peace river. From township 102 to township 107, a distance of thirty-six miles, the country is drained by Birch river. The country commences to improve with township 102 and continues to improve as you travel north. A peculiar feature in township 102 is an area of two or three square miles covered with large tamarack, all of which is dead from no apparent cause. I have learned since that tamarack died in the same way in Lake of the Woods country in Manitoba and it is ascribed there to the work of an insect. This area is peculiar for the reason that the soil is jet black humus, with no sign of clay, sand or the fibre of peat. Under these dead tamarack, large alder and ferns flourish, also quantities of black currant shrubs and a shrub of a similar fruit, which my men decided was a cross between the gooseberry and the red currant. This is the watershed between the Red and Birch rivers. Water flowing to Birch river was first met with in township 103, and trails of Chipewyan Indian hunters from Athabaska lake appeared. An elbow of Birch river is crossed in township 104, and the river runs with the line to the north end of township 105, when it bends to the east. Good agricultural land is found along this river and along all the creeks flowing into it, but inland from the water courses, the spruce and moss swamps prevail. The creeks however, are numerous and even when small seem to favour the growth of poplar and birch. With township 106 large open meadows alternate with bush land of mixed timber. Hay becomes very abundant and meadows were observed which have the appearance of dried out muskegs. A long saline slough, sixty feet wide, occurs in section 25, township 106, and a river one hundred and twenty-five feet wide, in section 1, township 107, which shows a slight current; it is also saline. This river joins Birch river and is no doubt the Stinking creek shown on maps of the district. Both the salt water courses referred to have channels as regular as artificial canals, and their sources are no doubt salt springs situated west of the meridian. A large open meadow marsh and lake occurs in the north end of township 107, and is called by the Indians Manuche lake. This is the wintering range for Indian ponies. The meadow is between five and six miles long and one mile wide, and at least two-thirds of it is hay, while the bottom is smooth and ready for the mower. I would estimate the yield of hay at over 6,000 tons. This meadow had been burnt off previous to our arrival and the bush was still smouldering. A peculiar feature was noted in connection with this grass fire. It occurred on September 16 and burned besides the hay, roots and surface loam of four inches down to the clay soil, and yet on my arrival on October 1 new grass had attained a growth of four inches. Another peculiar feature of this fire was that while the ground appeared black on the surface, our feet turned up a bright vermilion powder, nearly as fine as wheat flour. This powder may have been the ash of the surface soil, but I must leave it to geologists to decide. I may observe that the clay used by Indians to construct their fire places also burns to vermilion. The chemical constituents giving this colour on burning have no detrimental effect on the growth of plants, as instanced by the growth of grass referred to above.

Before work was brought to a close for the season at Manuche lake, I made a trip across country to the Hudson's Bay Company's post at the mouth of Red river, which

is situated about forty miles west of the meridian, and then up Peace river to Fort Vermilion. About half way between the meridian and Red river an entire change occurs in the appearance of the country. What I have so far described may be called moss country, as the ground, whether hill or dale, is covered with moss from a few inches to two feet in depth, according to locality. Now the moss is left behind and scrubby prairie is reached, similar in soil, grass, weeds and shrubs to many parts in the Saskatchewan valley. The only explanation of this change from moss to prairie which occurs to me, is the probably greater prevalence of fires during a long succession of years, in the area now covered with moss. The return of fire after fire would appear to have destroyed almost the last trace of organic matter, and this extensive region was moved back to the geological age when only lichen and moss covered the ground. That this country was once covered with a large forest of mixed timber there is sufficient evidence. The question now arises, did the removal of the timber and the organic matter in the top soil, leave behind barren clay? The rapid growth of grass at Manuche lake in cool autumn months, referred to above, would indicate that it did not. With the advent of a railway the more favoured prairie portions will be occupied, and later, settlement will spread out over and reclaim the moss country, and no such miracle will have been performed as the reclamation of swamp land in eastern Manitoba, between Beausejour and Whitemouth.

Before leaving this subject I may mention that the almost universal employment of the word 'muskeg' in the west, in connection with swampy ground of any nature, leads to much misconception, and is to be deprecated. The presence of moss and mosquitoes is to the average man sufficient evidence of muskeg. I am justified by indisputable facts, however, in stating that there is a comparatively small percentage of this north country which can be termed muskeg. Even the spruce swamps are found, in many cases, to have an undulating surface after a fire has passed over them, and I maintain that on the removal of the moss, good clay loam, or loam, with, occasionally, sand, will be found.

CLIMATE.

The summer of 1907 was spent in the Wabiskaw lake district. The early part of the summer must be regarded as unusual. An exceptionally cold winter with heavy snowfall was followed by a cool backward spring, and all vegetation was delayed from a month to six weeks later than usual. Similar conditions prevailed throughout Saskatchewan and Alberta. In July the thermometer registered between 70° and 80° during the day, and the nights were cool without being chilly, while rain fell on five days. August was of the same temperature, but the thermometer registered 28° on the night of the 10th and 29° on the night of the 11th. September was an agreeable month, with the exception of the 16th and 17th when snow and sleet fell to a depth of three inches, but no frost accompanied it, and it had entirely disappeared on the 18th. October was also a mild month until the 16th when two inches of ice formed on creeks and ponds, but canoes were used on Wabiskaw lake until the 22nd. November was bright and sunny, with only sufficient frost at night to keep ice firm. The first snow fell, to a depth of two inches, on the 2nd and about a foot on the 15th and 16th. The first part of December was very mild and rain fell on the 5th. Cold weather set in on the 14th and continued until the new year, when the lowest temperature was experienced, but nothing exceptional. The winter of 1907-8 may, as a whole, be regarded as mild and agreeable and as a fair average of the district. The spring of 1908 came on rapidly with the advent of April, and my horses commenced to feed along the banks of Wabiskaw river, in township 91, by May 1. May was a bright sunny month and brought on the vegetation in a wonderful manner, so much so that I saw hay already in stack at the outlet of Wabiskaw lake on June 7. It was wet in June, showers occurring almost daily. Between showers, however, there was bright sunshine and the foliage of trees and shrubs were at their best. Frost was reported by my assistant at

Burnt lake on the night of the 27th, but there was none where I slept that night, five miles east of the camp. July was bright and pleasant and rain fell on five days. Two degrees of frost occurred on the night of the 30th. August proved a wet month, rain falling on nine days, otherwise the weather was bright and warm, no frost occurring during the month. September was bright and sunny; rain fell on six days and frost occurred on the night of the 6th. October continued bright and sunny and light rains only occurred on the 1st and 5th. Frost set in at night for good on the 18th; snow fell on the 27th and 30th, and on the night of the 31st the temperature fell to zero. November was clear and crisp with the temperature fluctuating between 10° and 20°. I reached Athabaska river on my way out on the 24th and found it still open in the centre. Following the above record of the weather through the growing and harvesting seasons of both 1907 and 1908, I see no reason why grain and root crops should not mature. Frost is to be expected in any forest country, and in the cases noted, were probably local and not general. As daylight continues practically throughout the entire growing season, and the temperature rarely falls below 50° during the night, I would say that conditions were peculiarly favourable to the rapid maturing of grain. My own personal knowledge of the climatic conditions which prevail throughout the different seasons in the prairie provinces has been gained during thirty years almost continuous residence, and I am therefore able to state, with some confidence in the correctness of my opinion, that the climate of the north country is quite as favourable, if not superior, to that of the prairie country, and it is in no respect inferior to the climate of the most favoured portions of Ontario. The fact of tomatoes ripening in an open field at Red river speaks for itself.

MINERALS.

No time was at my disposal to prospect, but the following came under my notice. Tar sands occur on Wabiskaw river at Prairie river, which is incorrectly shown on maps as 'Pine' river. Float coal is found in the bed of Birch river and coal 'in situ' in township 78. The salt streams referred to indicate salt deposits, and sulphur springs occur between Mauuche lake and Red river. Iron seems a constituent of all the soils and accounts to some extent for the dark red brown colour of the waters of the rivers. Birch river affords favourable means of prospecting over a large area, and it seems strange that this large river should be so little known, and its location on the map so incorrect. The present local Hudson's Bay Company's officers know of it only as Birch creek where certain Chipewyan Indians hunt.

WATER.

The surface water in lakes and rivers is fresh and potable but is generally dark in colour. As no wells whatever have been sunk anywhere to any depth, I am unable to report on the supply available from that source. Springs are not numerous but such as were met with were pleasant to the taste.

WATER-POWERS

No falls of any height occur on any of the smaller rivers, but numerous rapids occur on the Wabiskaw, Bear, Trout, Red and Birch rivers, and on smaller streams, which would probably give heads of from eight to ten feet. The Vermilion falls or 'chutes' of Peace river have often been described, and estimating roughly, I would say that they were about five times the horse-power of the Chaudiere falls at Ottawa. Grand rapids on Athabaska river did not come under my observation.

STONE QUARRIES.

No rock was observed 'in situ' until Peace river was reached, where the Devonian limestone becomes available. This formation, however, furnishes poor building material. Shale in exposure along the rivers is almost plastic.

FISH.

Fish are abundant in all the northern lakes and form the staple food supply of the native population. The following species were observed, whitefish, jackfish, trout, dory, sucker and maria. The whitefish, however, is the chief fish asset, and they are caught in great numbers at Wabiskaw lake, Island lake and Calling lake, and a fish company is operating at the latter point. Trout are taken at Trout lake, but they are little relished by Indians as they are not to be compared with the whitefish as an article of diet.

ANIMALS.

There is sufficient evidence to place it beyond doubt that buffalo once occupied a large portion, and perhaps the whole, of the vast territory between the Athabaska and Peace rivers. Their destruction is explained by the forest fires, which, by altering conditions of soil, have substituted moss and spruce for the mixed timber of poplar, birch, spruce and balsam, and the many succulent plants and shrubs on which the buffalo subsisted. There is now no reliable information to be obtained from the present native inhabitants as they all seem to be of French extraction and Indian traditions have been lost, but the comparatively sparse original Indian population could have made but little impression on the herds which once roamed this country, wasteful as they are of animal life.

Moose inhabit the country in great numbers. Judging by their tracks and allowing for the numerous tracks made by one animal, it would be a conservative estimate to say that there was one animal to every ten square miles. During the exceptional winter of 1906-7, when the Government was called upon to assist the starving Indians at Wabiskaw and other points, individual hunters killed from ten to fifty of these animals.

Caribou are not so numerous, but are occasionally found, and a small herd was seen by members of my party in the Pelican mountains and two of these animals were killed north of the Wabiskaw.

Fur bearing animals were very scarce during the winter of 1907-8, and I understand that the fur catch is even smaller for the present winter.

Wolves, which have been reported numerous, were not seen by any members of my party and I doubt their existence in anything like packs.

The beaver, which have been protected by the Government for the past few years, have begun to leave their holes along the banks of the rivers and to work their way up the creeks to their natural habitation, and where no doubt gestation and caring for their young can be followed in peace. Numerous cases came under my notice where they have constructed dams and lodges in readiness for the coming winter, and on my arrival at Edmonton, I was very much disappointed to learn that Indians were to be allowed to take them this winter, under the plea of starvation. How senseless this plea is, the reference to moose above made would alone prove, and their neglect to store fish for their own use, as well as for their dogs, and also their neglect to plant potatoes are other good reasons showing that they deserve no assistance whatever, and it is a great pity to risk the extermination of these animals. Beaver should be regarded as a valuable asset, and placed under the direct care of the Government, even if it were necessary to appoint special guardians to see that regulations with regard

to taking them were strictly observed. Under the regulations until lately in force, which protected them to a certain extent, many were killed for food and I have no doubt the pelts reached a market by underground routes.

GAME.

Water-fowl were very numerous and along Wabiskaw river a collection could soon have been made of the fancy plumage varieties. The teal duck seems to favour the Pelican canoe route. Partridges were very scarce until the Red river country was reached, when both the ordinary and the spruce varieties became plentiful. Prairie-chicken were first seen in township 100, and they became more numerous as we approached Peace river.

In extenuation of the unusual length of this report, I would say that in view of the attention now being given to this north country and of your instructions to me, I have endeavoured to give all the information in my power.

I have the honour to be, sir,
Your obedient servant,

A. W. PONTON, D.L.S.

APPENDIX No. 37.

REPORT OF W. R. REILLY, D.L.S.

RESURVEY AND RETRACEMENT IN NORTHEASTERN SASKATCHEWAN

REGINA, SASK., February 8, 1909.

E. DEVILLE, Esq., LL.D
Surveyor General,
Ottawa.

SIR,—I have the honour, in accordance with your instructions, dated March 28, 1908, to make the following general report of my season's work, which included retracements, resurveys and miscellaneous surveys in the Prince Albert district.

Instructions were to use the same transport that I had the previous season. This outfit was in the charge of Mr. Charles Hayes, on Saskatchewan river north of Lloydminster.

I was fortunate enough in securing at Saskatoon two of my old hands that were used to handling the outfit. These I sent from Saskatoon on May 5 to take the transport to Prince Albert, where I was to make up my party.

On Friday, May 15, I received a message from these men stating that they had reached Prince Albert with the transport.

On Monday, May 18, I left Regina for Prince Albert, where I met Mr. L. B. Kingston, my assistant, whom I had instructed to be in Prince Albert on May 15.

On Tuesday I organized my party and on Wednesday I left Prince Albert for township 49, range 23, west of the second meridian, taking the old trail to the forks, which was in fair condition with the exception of a few soft holes.

My instructions, dated April 25, were to make a retracement of that part of township 49, range 23, lying north of the river, and to report as to the necessity of a resurvey of the south part of the township; I immediately went over to the south part and reported that a retracement was needed. I forwarded you a petition signed by all the settlers that could be found, asking for such retracement and subsequently received your instructions to make it.

I completed the retracement north of the river on June 9, and on the 10th I ran the west boundary of the township on a straight line south to the township corner feeling sure that it would strike west of the township corner, which it did, showing a bend in the outline. It rained steadily the two following days, and on the 13th I moved into township 49, range 22, and subsequently from there into township 49, range 21.

After receiving your instructions, dated June 26, to complete the retracement of township 49, range 23, I returned from township 21 to this township on July 25, and finished the survey on August 17, with the exception of some traverse work.

Saskatchewan river runs through the township from the northwest corner of section 18 to the southeast corner of section 36. It has a number of large bends. Its banks are broken and vary from twenty to one hundred feet high alternating from one bank to the other. Generally where it is high on one side it is low on the other. The current is swift in high water with no rapids of any account. In low water several strong rapids are formed.

The country north of the river gradually rises to the north to a height of about two hundred feet above the river. The surface is rolling slopes, flats and steeps with a heavy growth of poplar in most places, the heaviest being on the west side of the township. A few scrubby openings occur on sections 35 and 36. Many large patches of swampy ground are found dotted with clumps of willow.

Garden river meanders from the northwest corner of section 32 through sections 32 and 29 and into the Saskatchewan on the east side of section 20. It is from thirty to forty feet wide, one to four feet deep and has a rapid current. Some clumps of spruce are found along the banks near the mouth.

With the exception of a short distance from the Saskatchewan which is broken the most of the country is but slightly rolling and generally flat along the south part of the township.

A number of fresh water sloughs are scattered over the township. They are more numerous in the southeast quarter of the township.

Two large lakes were traversed; one cuts sections 15, 10 and 11, the other one is in sections 11 and 12.

An old surveyed trail from Prince Albert to the river forks passes through the township from section 18 to section 24. It is being abandoned in places where roads along section lines are being made to take its place.

The greater part of the south half of section 18, sections 7 and 8 and a part of sections 8 and 5 has been covered with a heavy growth of thrifty jackpine, a great quantity of it being large enough for railway ties. This ground has been pretty well run over and a great amount of building and other material taken off. Heavy bluffs of poplar are found on most sections, this being a poplar bluff country with large scrubby openings.

The homesteads south of the Saskatchewan are pretty well taken up.

A couple of farms on odd sections are being worked, but generally speaking the country has a backward appearance.

Away from the jackpine ridges the soil is good. Hay and water are plentiful and fuel and building material are seen in large quantities. A small spring creek with excellent water runs through section 18. Another creek known as Steep creek runs through sections 15 and 22.

This is a good mixed farming district and an excellent cattle and hog country. Steep Creek post-office is on the southwest quarter of section 24.

I moved into township 49, range 22, on June 13. My instructions of June 6 were to make a retracement of that part of this township lying north of the river. The south part had been retraced in 1893, and the north boundary recently.

Saskatchewan river enters the township on the west, at the southwest corner of section 31. It flows in a very zigzag course across the township, being joined on the southwest quarter of section 24 by its south branch. The banks are much the same as in range 23. The stream is much swifter being virtually a succession of rapids from the west boundary to the forks.

A ferry was being put in by the Saskatchewan government a few chains east of the west boundary.

Very high water prevailed during the time of survey, which made crossing tedious.

Very few original markings were found north of the river. I ran all lines south and connected with monuments south of the river.

The country slopes back from the river to a height of about two hundred feet.

Section 31 is rolling in the north with long slopes in the south, to the river. It is the only part north of the river that can be said to be fit for cultivation.

From section 31 to section 36 along the north boundary are large spruce and tamarack swamps or muskegs with intervening jackpine ridges. Small swamps and jackpine ridges with patches of poplar cover the remainder of the township.

The river valley is formed by ranges of hills that stretch from bend to bend. Between the bends are large flats which are covered with poplar and willow.

In the flats in sections 26 and 27 are two crescent shaped swamps that are apparently old beds of the river.

A heavy belt of poplar six to twelve inches in diameter covers the ground between these swamps and a large amount of young poplar covers the flats and slopes in sections 22, 23 and 24. The only prairie openings are on section 31. Poplar, jackpine, tamarack, willow and other scrub cover the ground.

A large amount of poplar is large enough for building and other purposes. A good deal of jackpine is scrubby. It is not very extensive in any place, but by going over the whole area a large amount of railway ties could be made.

No minerals or stone quarries were found.

Game was scarce, some traces of mink, foxes, coyotes, etc., were noticed and frequent tracks of jumping deer were seen.

Many points on the river were good places for the erection of a dam and developing water-power. An extensive power could be obtained.

There does not appear to be any use for such power on the ground, and only such a scheme as would transmit the power to a distance is likely at any time to receive consideration.

I completed the survey of the township on Friday, July 3. On the following day it rained, which prevented moving.

On Monday I started for township 49, range 21, which is below the south branch of the river. To cross this branch I had to make a very roundabout trip to Mitchell's ferry, in township 48, range 23, thence by the old Fort a la Corne trail until we struck the old Fort a la Corne trail to the river forks.

The trails on account of frequent heavy rains were in many places almost impassable; we had to cut trails around impassable spots, fill many places with brush, etc., and it took three days from starting to get camped, on July 8, in township 49, range 21. My instructions dated June 6 were to make a retracement of that part of the township lying north of the river, and report as to the necessity of a resurvey south of the river.

I reported progress of the work and continued running lines until July 22 when I received your instructions dated June 26 to complete the retracement of township 49, range 23.

Awaiting your further instructions about township 49, range 21, I deemed it advisable to return to township 49, range 23 and complete the retracement of that township as hereinbefore described which I completed on August 17.

After completing township 49, range 23, I started eastward again intending to return to township 49, range 21, if I did not receive further instructions.

On the road I received your instructions dated August 13, stating that the work on township 49, range 21, was not to interfere with the work advertised under the Dominion Lands Act.

I, therefore, went into township 46, range 22 to make a retracement of that township according to your instructions dated June 29 and got camped there on August 21.

Not much difficulty was found in the retracement of this township. A large number of the old markings were found and where new monuments were placed to define the corners not marked, they did not interfere much with the supposed boundaries or make many changes in improvements.

On the north boundary of section 21 a part of the old quarter section post was found 2.30 chains west of the centre of the section. I could not find the bottom of the post nor any traces of the bearing trees. The point was not satisfactory to me and the owner of the northeast quarter of the section was perfectly satisfied to have it placed in a proper position. As no one could give any information about it, I therefore placed it midway between the section corners.

This township is rolling or undulating, slightly broken along the north by Peonan creek, in the southwest by a succession of lakes and sloughs and in the east by large irregular lakes.

The creek contains excellent water and does not dry up in the summer. The water of the lakes and sloughs is slightly alkaline in nearly every place.

A considerable portion of the ground is covered with willow and poplar bluffs, the poplar in all cases being large enough for fence rails and the willow for fence pickets. In the east and northwest parts of the township there is a quantity of poplar large enough for building purposes.

The soil is a loam of good quality and produces good crops of wheat, oats, barley, &c., and excellent roots and other vegetables. On the high ground not much damage was done by frost, but low places suffered considerably.

The district is best adapted for stock raising, which is followed to a considerable extent, and dairying is receiving more attention every year. A quantity of cream is now shipped by the different farmers to the creamery at Birch hills.

Hay can be cut around nearly all the sloughs scattered throughout the township. There is a large quantity available in the southwest and eastern portions. There is no water-power available in the township. No minerals of economic value were met with. Ducks are numerous, prairie-chickens are plentiful, while geese and sand-hill cranes are scarce. Coyotes, skunks, gophers and other fur bearing animals were seldom seen. Very little of the land on odd sections has been cultivated.

The most of the settlers in this township are Scandinavians from the northwestern United States, who appear to be very prosperous. They have made permanent improvements, and in a short time will have excellent farms. A considerable amount of road improvements has been made. The road on the east side of sections 29 and 32 and on the north of sections 21 and 22 has been graded and a number of other improvements done. The Canadian Northern railway cuts the township from section 31 to section 22. Farm trails run in many directions and were in good condition. The lines and mounding were finished on September 3.

After the completion of township 46, range 22, I moved into township 46, range 21, to make a retracement of that township according to your instructions, dated June 26. This township is very much like township 46, range 22. The land is rolling, with bluffs of poplar and willow, with open patches and sloughs intervening between the bluffs. The only continuous bush occurs in the southwest corner of the township. The trees in all cases are large enough for fencing purposes, and on every section there is poplar of a size suitable for building purposes. The soil is a sandy loam of good quality, with a subsoil of clay and, where cultivated, appears to have raised good grain crops and excellent roots and other vegetables. The most of the grain was cut in time to escape much damage by the frost this year, but last year, as in many other districts, it was badly damaged. The whole township is much broken by sloughs and lakes. A large body of water occurs in section 30, with a good deal of swamp about it, another with good shores in section 21, and a very much broken and irregular one in sections 35 and 36. A large lake containing small scattered islands breaks the east boundary of section 36, and another surrounded by small hills takes up a good portion of the northeast quarter of section 24. The strip on the east side of the township, consisting of sections 1, 12 and 13, is very much broken by sloughs. None of these bodies of water appear to have outlets, and most of them are alkaline to some extent, but not enough to make the water unfit for stock. Carrot river contains good water. It flows northerly in a narrow valley through a very crooked channel from twenty to twenty-five feet wide and three to four feet deep, skirting the east boundaries of sections 22, 27 and 34. Practically all the sloughs are surrounded by strips of good hay land. There are no very large single areas in any one place. Upland hay is also good. The district is well adapted for mixed farming, and is an excellent cattle and dairying country. No water-power of practical use is available other than a small power that could be

developed on Carrot river by flooding a considerable area of land. It would not be permanent and of no use in winter. No minerals of economic value were seen. Game, exclusive of ducks, is not plentiful, but there are a few prairie-chickens and rabbits. Geese and sand-hill cranes were entirely absent. Coyotes, skunks and badgers were fairly plentiful. Most of the even sections are occupied, mainly by Scandinavians from Europe and the northwestern United States. They are making good progress, and bid fair to make splendid farmers. The original survey had been well done. I found the most of the original markings, and I made no changes of any extent from supposed corners in placing posts to mark undefined corners.

A graded road made by the Saskatchewan government runs along the east boundaries of sections 19, 30 and 31. This road extends north across Peonan creek in the north township and south to the village of Kinistino.

Following your instructions, dated June 26, I ran the north boundaries of sections 35 and 36 and the east boundary of section 35, township 45, range 21, on September 19, removing temporary posts planted by Mr. Hubbell in 1905 and erecting monuments at the northeast corner of section 35, at the quarters on the north boundaries of sections 35 and 36 and the east boundary of section 35. None of the original monuments at these corners could be located.

On September 21 I moved into township 44, range 22, to complete the retracement of that township according to your instructions, dated September 4. I followed the trail on the left side of the river passing near the village of Kinistino on the southeast quarter of section 29, township 45, range 21. Crossing Carrot river on a bridge on a graded road on the east boundary of section 7 in this township, we travelled across section 6 to the east boundary of range 22 and south into township 44, range 22. In this township I retraced the two interior meridians between the centre of the township and the west boundary, the north boundary of sections 7, 8, 9, 19, 20, 21 and 24, the east boundaries of sections 23, 26, 35, 25, 24 and 36, and traversed six lakes.

Speaking generally of this district, it is a rolling poplar bluff country with large prairie openings and many sloughs and lakes. It presents special advantages for raising grain, cattle, horses, hogs and poultry and for dairying. It has natural advantages in being well watered, good soil, with an abundance of hay and a fair supply of fencing and rough building material. A number of settlers have taken up homesteads. They are making good progress, and are apparently doing well. The Saskatchewan government has done this season a considerable amount of grading on a road on the east boundaries of sections 15 and 22 and extending into section 26. According to instructions, dated June 26, I erected monuments to more clearly define the southwest corner of township 45, range 21.

From township 44, range 22, I moved into township 47A, range 24, on October 9, to make a retracement of that township and township 47A, range 25, according to instructions dated September 4. I returned by the same route around the east end of Waterhen lake until I struck the road running westward from Kinistino to Birch hills, on the south side of the Canadian Northern railway. From Birch hills a road allowance running north, on which improvements have been made, leads into township 47A, range 24, and an Indian reserve cuts the township, making sections 18, 17, 16, 15, 22, 23, 26 and 35 fractional.

The original survey of this township was not satisfactory. In 1890, Mr. J. L. Reid, D. L. S., made a partial resurvey and my instructions were to retrace Mr. Reid's survey where it was found to be satisfactory. As I proceeded with the survey it appeared to be satisfactory to restore Mr. Reid's survey with the exception of the east boundary of section 4. The particulars of this boundary were reported to you from time to time, and I received instructions not to make a survey affecting this boundary. Some correspondence took place in reference to the position of Indian monuments defining the north boundaries of sections 16, 17 and 18. Finally the mounds on these boundaries were adjusted from the Indian monuments in accordance with your

instructions, but it appeared from further search that you have no record of an Indian monument being placed on the north boundary of section 18 where it was found by me. Before leaving the field I received instructions to return to this boundary, but I reported that weather conditions were such that the trip would be futile. You still have this matter under consideration. I retraced the outlines, interior meridians, and cross lines in this township, passing over the east boundary of section 4, and south boundaries of sections 3 and 4, and erected a mound as on a correction line, on Reid's meridian at the southeast corner of section 9. I traversed Saskatchewan river forming the west boundary of section 7 and a lake cutting sections 10 and 11. The surface is rolling in the southwest quarter and slightly rolling in the southeast quarter of the township. It is comparatively level in sections 24, 25 and 36 and along the Indian boundary. Many fresh water sloughs of small extent dot the south part of the township. In the north they are more numerous and larger, covering a considerable part of the surface. A large marsh extends across section 3 into the north part of section 4. A drain has been dug in this marsh through section 4 into section 5 following a small creek running through section 6. Large prairie openings occur in the south part of the township and a few small scrubby openings in the north. Poplar with willow, alder and hazel bush cover the greater part of the surface. Clumps and belts of poplar with timber large enough for rough building, fencing and fuel, are found on every section. Hay of good quality is fairly plentiful in the tier of sections along the south boundary. A large quantity can be cut from many sloughs in all parts of the township. The soil is a good quality of loam and will produce good grain and root crops. Throughout the township the ground is much broken with sloughs, which impair its value for farming purposes. On the other hand the close proximity of a railway station enhances its value to a large extent. A number of homesteads have been taken up recently and a fair start made at farming, which promises well. A few older settlers on the south part of the township have large improvements made.

While camped in township 47A, range 24, I retraced the south and east boundaries of fractional township 47A, range 25. It consists of a part of section 1, and the southeast corner of section 12. I traversed South Saskatchewan river forming the west boundary of this township. The river bank is heavily wooded with poplar of small size and a heavy growth of willow, poplar and alder underbrush. The bank extends back from the water about ten chains, in gentle slopes, and rises to a height of about one hundred feet. A small creek in a deep ravine with high sloping wooded banks runs through the south half of section 1. South of the creek the land is mostly rolling prairie with scattered bluffs of poplar and clumps of willow and poplar brush. North of the creek the ground is rolling and heavily wooded with poplar and a heavy growth of poplar, willow, alder and hazel underbrush. There are some large patches of young growing poplar six to ten inches in diameter. Scattered trees of large dimensions are found all over the area. The soil is a rich black loam on a clay subsoil. There are some odd fresh water sloughs in the south part of the township, some of which will produce a small quantity of good hay. While in township 47A, range 24, I received instructions to investigate a report that the quarter section monument on the north boundary of section 32, township 46, range 24, was lost. I had very little trouble in locating this corner which was a wooden post under water in a slough. I renewed it with a long poplar post which shows well above water. During the season a large amount of traverse work was not done, which was considered advisable to leave until it could be done on ice.

Apart from townships which I retraced, I received instructions to do traverse work in township 45, range 21, township 46, range 23 and township 42, range 27. These were townships in which retracements were recently made.

By November 12, I had completed all work in township 47A, range 24, and vicinity. Water areas had now frozen over and I was able to do traverse work rapidly. I

determined to do all the work in the least time, and accordingly moved into township 46, range 23, and completed the lakes in that township. I had instructions to make a survey on the east side of this township, to connect township 45, range 22, first system, with township 46, range 23, third system, which I did.

From township 46, range 23, I moved in succession into township 46, range 22, township 44, range 22, township 45, range 21, and township 46, range 21, completing all traverse work in these townships on November 28. A heavy snowstorm set in the following day, obliging me to change my rigs from wheels to runners before moving camp. This I readily performed by making temporary plank runners on which I placed the democrat boxes. I was unable to procure shoe iron until I reached Fort a la Corne. The running gears I shipped by freight from Kinistino to Prince Albert, where they are stored with the other transport goods. From this camp I moved into township 49, range 21, to make a new survey of that township. I was working in that township when I received your instructions to disband my party. I worked three days after receiving your instructions, doing work I considered necessary, to leave what I had done in proper shape to be completed at another time.

On December 21 I started for Prince Albert for the purpose of traversing two lakes in township 49, range 23, on the way. These I completed, and on December 24 I arrived at Prince Albert and paid off my men. On the 26th I made an agreement with Mr. James Bayliss, Lost River postoffice, for wintering the horses, while the transport goods were stored with Messrs. Fowlie and Sutherland, Prince Albert.

On December 28 I went by train to Rosthern and drove to St. Julien for the purpose of traversing lakes in township 42, range 27, west of the second meridian. A few hours after arriving at St. Julien a blizzard started, followed by intense cold weather, which lasted two weeks. I found it impossible to do the work, and after being stormed in for a couple of days it was with some difficulty I got back to Rosthern to catch the train on which I got home to Regina on January 1, 1909. I returned to Rosthern on January 26, and from there I made a successful trip to St. Julien, completed the traverse work in township 42, range 27, and got home to Regina January 29, 1909.

My season's work did not extend over a large enough tract of country to cause any marked difference in climatic conditions. The whole district presents much the same general features. It is a wooded country with many prairie openings, while patches of swamp and small lakes and ponds are found in every direction. Saskatchewan river is joined on the east boundary of range 22 by its south branch. Both are large streams. Saskatchewan river forms part of the waterway from Winnipeg to Edmonton, on which in former years a summer service was maintained. It is still navigated to some extent as far up as Prince Albert.

The temperature of the seasons in the north country does not differ materially from that of the prairie plains to the south. In each district spring comes about the same time, early in April. In the north snow lasts a little longer in the spring, falls a little earlier in autumn and to a greater depth in the winter. It is not unusual to have good sleighing in Prince Albert district when there is bare ground on the plains to the south.

In a range of years over the whole country marked differences in weather conditions have prevailed for the same season in different years. In the north country the wooded growths and the many water areas are no doubt the causes of more frequent rains than the prairie country is favoured with.

Experience is teaching different methods of farming in this country, so that unfavourable climatic conditions are being largely overcome. The man that puts energy and intelligence into his work is assured of a measure of success under unfavourable conditions and when favourable conditions prevail, he reaps a rich reward.

To the settler of means who can farm on a large scale perhaps the prairie country offers the most likely opportunity of large gain. The north country offers special inducements to start farming with small means. A man has the advantage of good buildings for little more than the labour, wood for the chopping, and an opportunity of winter work in the woods if he so desires.

I have the honour to be, sir,
Your obedient servant,

WM. R REILLY, D.L.S.

APPENDIX No. 38.

REPORT OF E. W. ROBINSON, D.L.S.

SURVEYS IN THE RAILWAY BELT NEAR SHUSWAP LAKE.

Ottawa, February 13, 1909.

E. Deville, Esq., LL.D.,
Surveyor General
Ottawa.

Sir,—I have the honour to report that in accordance with your instructions I left Ottawa on April 18, 1908, proceeded to Kamloops, B.C., and consulted with Messrs. J. E. Ross, D.L.S., and T. H. Plunkett, D.L.S., as to the division of surveys projected in the Kamloops district. After discussion it was decided that Mr. J. E. Ross should undertake the work in the neighbourhood of Kamloops, Mr. T. H. Plunkett from Golden westerly, and that I should work from Sicamous Junction easterly.

I accordingly organized my party at Kamloops and on May 1 moved to Sicamous Junction. I proceeded from there about four miles northeasterly along the valley of Eagle river, camped in section 17, township 22, range 7, west of the sixth meridian, and completed the surveys in this township.

Eagle river valley, having an elevation of about 1,200 feet above sea-level, runs approximately in a northeasterly and southwesterly direction and has an average width in the township of from forty to sixty chains. Eagle river empties into Shuswap lake near Sicamous Junction; it averages about two and one-half chains wide and the current in high water runs about four miles per hour. There are rapids and sandbars in places making the river generally unnavigable although it is possible in low water to pole up in a canoe.

The soil in the valley bottom is sandy loam about twelve inches deep overlying a sandy clay subsoil. Samples of both the soil and subsoil have been analyzed and the report states that they are both excellent. Sloughs and marshes occur all through the valley. These when drained could be used as hay meadows. The sidehills bordering the bottom land are usually too steep and rocky to admit of successful cultivation but benches can be found here and there that could be utilized. The soil on these benches is usually richer than the bottom lands.

This valley seems well adapted for fruit growing and mixed farming; no summer frosts were experienced and the land being well watered and out of the 'dry belt,' no irrigation should be necessary. A fire having run down the valley some years ago very little large timber is left; an occasional strip of cedar, hemlock, fir and pine is found while the remainder is covered with second growth of the above varieties with poplar, birch and willow along the river banks.

Leaving the valley on June 18, I proceeded by gasoline launch and boats to the north shore of the main Shuswap lake pitching camp near the mouth of Manson creek in section 14, township 23, range 10. I was instructed to connect Block II of timber berth No. 240 to the township surveys. Considerable difficulty was experienced in locating this block, as it had been logged, of which I had not been informed, and fire had subsequently run over it. The soil through the southern portion of this township varies from a rich black muck with clay subsoil to a sandy loam with gravel subsoil. There is an excellent bench from one-half mile to one mile in width lying

about one-half mile from the shore. Several settlers have taken up homesteads here and although none of them have very much land under cultivation, their efforts so far have been crowned with success. Standard fruits and strawberries seem to do especially well, and in view of the results obtained here and in other sections of the Shuswap lake district where fruit growing has been practiced for a considerable number of years, I am of the opinion that Shuswap lake will prove to be one of the best fruit growing sections of British Columbia.

Leaving here on June 26, I returned to Sicamous Junction and from there went about two miles east to the south side of Eagle river where I commenced the survey of timber berth No. 528, Block V. This berth takes in the greater portion of the valley of Owlhead creek, a tributary of Eagle river, and extends southerly up the mountain side reaching to Cariboo plateau.

The valley of Owlhead creek is well timbered with cedar, hemlock, Douglas fir and white pine. Another belt of good timber is found about one mile west of the northwesterly corner of the limit, and consists of hemlock, cedar and Douglas fir. The interior of the limit is largely second growth with occasional large trees of fir and tamarack. There is also some good cedar, hemlock, fir and pine lying to the north of the northerly boundary of the berth and principally in the following sections: northeast quarter of section 4, southeast quarter of section 9, south half and northeast quarter of section 10, northwest quarter of section 11, and northwest quarter of section 12, all in township 22, range 7.

The only land having any agricultural value lies along the valley of Owlhead creek. The soil consists of eighteen to twenty-four inches of rich black muck with a subsoil of gravelly clay. A small quantity of slough hay could be cut in the beaver meadows at the head of the two branches of this creek. Approximately fifty acres in all could be used, although this would necessitate some improvements in the way of drainage and clearing.

On September 30, I moved to Malakwa, B.C., and started work in township 23, range 6, adding on sections to the existing surveys. Fire has run through the valley destroying most of the timber, consequently the clearing of the land would be comparatively easy. The soil is a sandy loam with considerable surface rock. The sidehills bordering the valley are covered with second growth fir, cedar, spruce and pine with poplar and willow in places. They are usually too steep to admit of profitable cultivation, although small benches exist which might be utilized, the soil usually being a rich loam. Summer frosts occur occasionally but as a rule are not very severe, and these would probably disappear when all the adjacent land is under cultivation. Mr. Wolsey, the postmaster, a resident here for about twelve years, states that he has never had a failure with his strawberry crop. The land seems best adapted for mixed farming, Revelstoke providing an excellent market for all produce.

On October 19, I moved to Craigellachie, which lies in the east part of township 23, range 6, and commenced the surveys there.

The valley of Eagle river in this district is from forty to seventy chains wide, narrowing down to a few chains at the confluence of the north fork and the main stream. Fire has run over a portion of the valley, but leaving generally a strip of good timber, consisting of cedar, spruce, hemlock and fir along the river bank. Over the burnt area poplar, birch, alder and willow is now growing. The soil is a rich sandy loam from nine to twelve inches in depth, overlying a sandy clay subsoil. The land is marshy in places, caused largely by beaver dams, but any portion could be easily drained, there being a gentle fall to Eagle river. The river apparently overflows its banks at extremely high water. The land appears to be well adapted for mixed farming; dairying in particular should be very successful as the rainfall seems to be large and consequently good pasturage could be maintained. We repeatedly had heavy rain showers, during which three or four miles down the valley no rain fell. The sidehills on the north side of the valley are steep and sparsely covered

with small cedar, fir, poplar and willow. The soil is a light sandy loam with a large amount of surface rock and apparently of little value for agriculture. Over the side-hills, on the south side of the valley a severe fire has run in some places almost sweeping the land clean. Portions of this could be used for agricultural purposes as the slope is not excessive and some good level benches exist.

On November 30, I moved to Griffin lake, in township 23, range 4, to traverse Eagle river, across sections 19 and 20.

The valley here is narrow and has been fire swept. Small second growth poplar and birch have commenced to cover the land. The soil is a sandy loam and very rocky. Summer frosts are reported to be prevalent. The land would make fair pasturage and dairying might be successful. A good market for any produce would be the lumber camps and sawmill on Three Valley lake, about three miles distant.

On December 4, I moved to Revelstoke, and from there about three miles down Columbia river, camping on the west side of the river. I traversed the west bank of the Columbia, in township 23, range 2, together with the islands in the river, but was unable to complete all the work outlined in this township, owing to inclement weather and the depth of snow.

The land on the west side of Columbia river is rolling with a modern slope from the river back to the foot of the mountains.

Most of it is well timbered with cedar, spruce, hemlock and pine, although in places fire has run over it some years ago, and this portion is now covered with dense second growth of the foregoing varieties, consequently the clearing of the land would entail considerable expense. The soil is a sandy loam with some surface rock showing as one approaches the base of the mountain.

The country seems adapted for mixed farming and Revelstoke, a divisional point on the main line of the Canadian Pacific railway, would prove an excellent market for all produce.

The valley of Columbia river, south of Revelstoke, will no doubt eventually be a thriving agricultural country, as there is a considerable quantity of good land on both the east and west sides of the river.

At present access to Revelstoke by road from the west side of the Columbia is impossible. A wagon bridge, however, under project to cross the river at Revelstoke and then with a wagon road down the west side of the Columbia, this objection will be overcome.

I closed the season's operations on December 30, moving into Revelstoke that day. On December 31, I proceeded to Kamloops and stored my outfit, and on January 2, 1909, left Kamloops for Ottawa.

I have the honour to be, sir,
Your obedient servant

ERNEST W. ROBINSON, D.L.S.

APPENDIX No. 39.

REPORT OF JOS. E. ROSS, D.L.S.

SURVEYS IN THE RAILWAY BELT, KAMLOOPS DISTRICT.

KAMLOOPS, B.C., February 21, 1909.

E. DEVILLE, Esq., LL.D.,
Surveyor General,
Ottawa.

SIR.— I have the honour to submit the following general report on my survey operations in the railway belt, British Columbia, during the season of 1908, which were confined to the westerly or 'dry belt,' portion of the Kamloops district, extending from Lytton station on the west to Shuswap station on the east.

I began the season's work on March 9, a few days after I had completed my returns of the previous season, as I had instructions from you stating that as the new plans for several townships to the south of Kamloops could not be issued owing to discrepancies between the old and new surveys it would be necessary for me to investigate the matter as soon as possible and forward the results to the Department.

After finishing this work and making some subdivisions in the same neighbourhood I made arrangements with the other two parties in the district by which I was to continue the work westerly while they would take up the work in the easterly portion.

But I had only got well started in this direction when I received instructions from you to go back and make corrections of some mistakes in the old surveys in the townships on the north side of Kamloops lake. These mistakes had been found by myself in 1906 and more fully investigated and confirmed by the late Mr. Stacey in 1907. The corners had to be shifted and new lines run.

On finishing this work and a few additional small surveys in the vicinity I decided to work westerly so as to lose as little time as possible in moving back and forth.

I might mention here, to show how the general work of the season was interrupted by the resurvey of old surveys, that before the end of the season I was again instructed by you to make further investigations of discrepancies in the neighbourhood of Campbell lake. This was a continuation of my first work of the season.

These resurveys are not without their unpleasant features. To begin with, doing work a second time always has a dispiriting effect. A cause of much vexation is the difficulty in picking up the old line in a hilly country. Usually the new line is just far enough from the old one to give what appears to be a lot of extra work. To avoid this one has to resort to offsetting which involves calculations, simple in themselves, but conducive to mistakes. An annoying obstacle met with in the woods here is the barbed wire fence on the boundaries of grazing leases. It is almost impossible to fell the trees without destroying the fence. It is a relief, therefore, to know that all the discrepancies in the old surveys so far as known have been eliminated.

In proceeding westerly from Kamloops lake I made surveys at nearly all the railway stations from Savonas to Lytton.

On finishing the surveys to the west of Kamloops, I made several small surveys in the North Thompson valley. One of these surveys had been a long standing one on the list as I had not been able to make it before, although I had attempted to do so several times. A resurvey of lot 338 was necessary in order to obtain the areas of

adjoining quarter sections and this is where the difficulty came in. All the corners and boundary marks had been lost as well as the notes of the original survey. It was only through an arrangement between the agent of Dominion lands and the owner that the survey was made possible. The latter agreed to relinquish his claims on the lot and to accept instead the same area as nearly as possible described in sections and fractions thereof in accordance with the Dominion survey system.

On completing the surveys on the North Thompson I resumed the work to the east of Kamloops and continued easterly for the rest of the season, reaching as far as Shuswap.

On account of the similarity of the whole country operated in it will scarcely be necessary to give a description of the different parts surveyed. The general character of the country may be briefly described as follows:—

The main central valley, through which the Canadian Pacific railway runs, lies along Thompson river. The general direction of the river is a little south of west. Above Kamloops, where the North Thompson joins, the river is known as the 'South' Thompson, below Kamloops, the 'Main' Thompson. The width of the valley varies greatly, averaging a little less than a mile. The elevation is about 1,000 feet above sea-level. The land in the valley was, naturally, the first taken up, and is now under cultivation except a few stretches where the soil is alkaline or where water is lacking for irrigation purposes.

The hills rise up on each side to a height of 2,000 feet or more above the valley within a distance of two or three miles, and extend northerly and southerly almost indefinitely, at least as far as the limits of the belt, reaching occasionally an altitude of 5,000 feet. Running north and south there are numerous smaller valleys along the different streams flowing into the Thompson, the North Thompson being the most important. On the tops of the hills, although the surface is much broken with ravines, gulches and rocky ridges, there are considerable areas of nearly level or gently rolling land. Much of this has lain idle for years as it was supposed to be fit only for grazing purposes, but now it is almost entirely taken up and settled on. So far the crops have been better than was expected, even where there was no water for irrigation. 3,000 feet above sea-level is generally considered to be the limit for general farming. From this altitude upwards the surface is more broken with a thicker growth of timber. At 5,000 feet there is usually a dense growth of jackpine. On the lower hills, the southerly and westerly slopes are either open or sparsely wooded; the northerly and easterly slopes are usually timbered with pine and fir, averaging fifteen inches in diameter. During the heat of summer the Thompson valley presents a very dry, burnt-up appearance, the cultivated fields being the only relief. As a rule good crops are obtained on the irrigated lands. The rougher and higher lands are being gradually brought under cultivation but the uncultivable lands must always constitute at least three-quarters of the total area.

I will now describe the several surveys to which the foregoing general description does not apply. Botanie creek runs nearly due south and joins Thompson river a few miles above Lytton station, situated at the junction of the Fraser and Thompson. The valley is well watered and densely wooded, forming a striking and most pleasing contrast to the parched hills of the surrounding country. A good wagon road leads from Lytton to the Indian reserve at the upper end of the valley, and it is much frequented on account of it being a cool, pleasant driveway. The good fishing in a small lake in the reserve is another attraction. The portion of the valley I surveyed lies at the north end, the lower part having been already surveyed. It is about a mile and a half in width and walled in by steep mountains on either side. There is some large timber, mostly on the east side of the creek, but the timber generally is small. As the surface is hilly and considerably broken, and the altitude over 3,000 feet above sea-level, I consider this part of the valley is adapted only for dairying and stock raising on a small scale. One settler has located here but he was absent at the time of the survey.

Chase creek valley is situated to the south of Shuswap station. The distance from Shuswap by the present road which takes a rather circuitous route to the settlement at the upper end of the valley where I began the survey, is rather more than twenty miles. A much better and shorter road could be obtained at a moderate cost by following the valley of the creek. The general direction of Chase creek is almost due north. The stream takes its rise high up in the mountains and in consquence maintains a fairly steady flow throughout the summer, and furnishes water in abundance for irrigating several large farms at its mouth. In general the creek bottom is very narrow, but in sections 7 and 18, township 19, range 12, there is a little good land but the soil is light. Farther down the creek, in sections 19 and 30, township 19, range 12, and sections 24 and 25, township 19, range 13, there is a larger area of level land, rather lightly wooded. In township 20, range 12, the valley reaches a width of half a mile or more. The land is densly wooded with cedar, spruce and cottonwood. The soil is a black loam with a few inches of vegetable mould covering. The hills are steep and wooded on both sides of the creek. On the east side there is some timber, fir and pine, suitable for milling. There is very little grazing land on the hills.

On Charcoal creek, which runs in a southwesterly direction into Chase creek near the northeast corner of section 19, township 19, range 12 there is a stretch of good bottom land. It begins about two miles up from the mouth of the creek and extends for a distance of three or four miles with a width of half a mile. It is densely covered with alder and willow. The soil is black loam with a good covering of vegetable mould. The hills rise up steeply on both sides; to the south they are covered with thick brush and windfall and on the north they are timbered with pine and fir with considerable open ground affording good grazing.

Both Chase and Charcoal creek valleys are subject to summer frosts. Most of the potato crop was killed last season the last week in July. In places not exposed to the early morning sun the injury was only slight. About half a dozen settlers have located in these valleys but only two were living on their claims at the time of the survey. Dairying and stock raising are the only branches of farming that can be carried on with success, and these only on a small scale.

I surveyed two mountain meadows, one in the Mamit lake country near the head of Skuhun creek, and the other about twenty-five miles to the north-west of Savonas. These wild hay meadows are usually found in a basin shaped depression on the tops of the hills at an altitude of 4,000 to 5,000 feet, quite often centered around a small lake forming the source of a mountain stream. To ranchers looking for fodder these meadows are very alluring but on trial they prove rather disappointing. The disadvantages often more than counterbalance the gains. At such high altitudes the winter is cold and long, and there is very little grazing on the hills as they are usually thickly covered with jackpine. Much time is lost going to and from them. An attendant for the stock is required and although his time is not fully occupied, there is no other work he can do to advantage. Considering these disadvantages I think the meadows are scarcely worth taking up.

Of the two hundred and eighty-nine days in the field, three were lost through bad weather, thirty-five were spent in travelling and moving camp, and the balance, excluding Sundays were occupied in running two hundred and ten miles of line, including retracements, resurveys and traverses. Surveys were made in thirty-four townships.

Game and all kinds of wild animals are gradually getting scarce. The coyotes, alone, although there is a provincial bounty of two dollars per head and the pelts are worth one dollar each, remain undiminished in numbers. These destructive little animals are very much dreaded by farmers keeping sheep and fowl; in fact only a few farmers keep sheep on this account.

According to reports there was considerable loss of timber from bush fires but we saw none nor any damage that had been done.

The season was an exceptionally good one from a surveyor's point of view, but the summer was too dry to suit farmers or ranchers.

Before closing I would like to refer to a matter which, perhaps, calls for some explanation. Those who have followed the surveying operations in British Columbia will have noticed that the same ground has been practically gone over every few years. This is unavoidable. In making the different surveys on the list I have endeavoured to do all the work necessary in the neighbourhood. At the same time one has to keep in mind the fact that most of the surveys are urgent and therefore as much ground as possible should be covered, otherwise some of the settlers will be subjected to long delays in getting their patents. As it is, some settlers, even in the vicinity of Kamloops, have been kept waiting owing to incomplete surveys, but this was due to unavoidable causes.

I have the honour to be, sir,

Your obedient servant,

JOS. E. ROSS, D.L.S.

APPENDIX No. 40.

REPORT OF A. SAINT CYR, D.L.S.

SURVEY OF PART OF THE SIXTH MERIDIAN AND PART OF THE FIFTEENTH BASE LINE WEST OF THE FIFTH MERIDIAN.

EDMONTON, ALTA., November, 1908.

E. DEVILLE, ESQ., LL.D.,
Surveyor General,
Ottawa.

SIR,—I have the honour to transmit the general report of my survey of the sixth meridian and the fifteenth base line, west of the fifth meridian.

I left Ottawa on April 9, and proceeded to Edmonton, Alta., to organize my party, Mr. Fred Sykes, who had been appointed as my assistant, arriving on the 15th.

On March 28, after receiving the information that my work would be in the mountains, I wired to the Edmonton merchants from whom I had bought my supplies, to forward them on the winter roads to 'Big eddy,' or preferably to Prairie creek, which is sixty miles nearer to the mountains, and thus ensure their delivery in a better condition and at much cheaper rates. But when I arrived at Edmonton, two weeks later, I learned that only one firm had succeeded in shipping a small quantity of my supplies as far as Prairie creek, and that the greater part were still stored at Lake St. Ann settlement. The two canvas boats which had been ordered for me had not yet been received in Edmonton on April 20 and, as I could not wait for them, I took two old ones which had been used by Messrs. Fontaine and Stewart, on their surveys. One of these boats had been stored at Mr. Angus McDonell's of Ray, and the other one at Messrs. Gariepy and Lessard's. However before leaving the city I wrote the customs officer to deliver to Messrs. Gariepy and Lessard the new ones as soon as received from the manufacturers and also advised you by letter what I had done in the matter. On April 20, I hired three teams and wagons to take the men and baggage to Lobstick river, and leaving Edmonton the next day arrived at Lake St. Ann settlement on the 23rd. The packers were sent to paddle river to fetch the Government pack ponies which had wintered in that locality. They were to meet the party at Lobstick river, which was as far as the teamsters would agree to go. Meantime I was arranging with the factor of the Hudson's Bay company for the transportation to Prairie creek of the supplies they had received for me from the Edmonton firms.

On April 24 we left Lake St. Ann and travelled to Donald MacDonald's, where we stopped for the night. Mr. MacDonald, who had the year before done all my freighting to the mountains, had succeeded in reaching Prairie creek with some of my supplies, but his ponies had suffered so on the trip that a month would elapse before they would be again in a fit condition to undertake a second journey. I relied now on the Hudson's Bay company to ship more in the interval.

Between Mr. MacDonald's ranch and Pembina river, the road was very bad and when we arrived at the river, which was quite high, the teamsters wished to turn back; but on being told that Lobstick river could be reached in another day, they consented to cross the Pembina, and brought our outfit to Asselin's store, where I paid them. The wagon road which we followed on this trip ends two miles and a half beyond this place.

On April 30, the packers returned with the horses; some were in fairly good condition, but the majority appeared to have suffered during the cold season. They required now to be fed hay and grain regularly before they would be fit to do the heavy work which would soon be required of them. So I bought all the baled hay that I could get at Lobstick river, and procured grain from the settlers in the vicinity of Isle lake and from some of the railway contractors at Wabamun.

While camped at Lobstick I heard from parties returning from the west, such discouraging reports concerning the old Jasper trail, in regard both to the scarcity of grass and the impossibility of travelling on it with heavily loaded ponies, that I decided to try another trail known as 'Jacques' trail. Previous to this year this trail has seldom been used by parties going to the mountains, because it is longer than Jasper trail, but as good pasture is found at intervals of ten or twelve miles, and as the road passes over high lands with very few small swamps, it proved to be the better one. It gave me also the opportunity of seeing the country between Chip lake and the valley of McLeod river.

Consequently, on May 11, we broke up camp and going northwards by a road which we had to open across township 53, range 8, we came to this trail, which we followed to the 'Hay buttes' five miles farther, where we camped. Our other camps were at 'Coldwater butte,' 'Blueberry hills,' where I lost one of my tents through the carelessness of some of my men, who set it on fire, and at the McLeod river (2,500 feet above the sea), where we arrived on the evening of May 14. The river was too high to be safely forded by loaded pack ponies, so on the next day all the baggage was ferried across in the canvas boats, and the horses swam the river.

The country east of the McLeod varies from undulating to high rolling, except through Blueberry hills, which have an altitude of 2,900 feet above the sea. The soil is good and the land can be easily cleared of the scrub, poplar and brush which cover it. Through these lightly wooded areas are many prairie openings and some hay meadows. This district is well drained by numerous creeks flowing in every direction. Timber sufficient for the needs of the settlers is also found in scattered bluffs all over the country.

From the left bank of the McLeod the trail leads to the top of a bench overlooking some large flats of partly open lands, where we saw the tents of some new settlers. For thirty miles this trail keeps well on the high land west of the river, crossing in that distance the valleys of Trout creek and Muskeg river. On May 20 we arrived at 'Big eddy' settlement. The horses, which had gradually improved, were loaded with more supplies, and we continued our journey to 'The Leavings.' Here the trail bifurcates; the branch over which I travelled in the fall of 1907 and which follows the fourteenth base line, has since been abandoned, as it is blocked by deadfall. We, therefore, took the southern trail along the left bank of the McLeod, which we followed for two days more, thence turning westward on Gregg's trail we crossed the divide (4,500 feet above the sea) between Athabaska and McLeod rivers, and came down to the last named river by the valley of Trail creek. On May 29 we pitched camp at the mouth of Prairie creek.

At Gregg's warehouse, which is three miles farther, I found the supplies which had been brought by McDonald's pack train. With what I had procured at 'Big eddy,' there was sufficient to allow me to proceed with my surveys till the end of June, but I expected that in the interval those being shipped from Lake St. Ann settlement would be delivered here.

Opposite the mouth of Prairie creek Athabaska river flows in one deep channel, and its crossing is always effected on rafts, while the pack ponies have to swim. The force of the current near the bank is, however, somewhat broken by an island which lies close to the right shore and a short distance above the crossing, while from the opposite shore projects a rocky point below which is a stretch of slack water which materially helps in effecting a landing with loaded rafts.

After transferring the outfit to the left bank of the river, we proceeded to the valley of Gregg creek and camped three miles south of lower Gregg lake. Whilst the men were building a cache I sent the packers to Prairie creek for the other supplies, which had just been brought from Lake St. Ann settlement. When they returned to camp with the loads I found that although a great deal of the provisions had been utterly spoiled by water, we still had enough left to last for four months.

The advantage to be gained by putting my depot in that locality was twofold. I would not again have to cross the Athabaska, which remains very high during the whole summer, and in cases of urgency my supplies at all times would be easy of access, because all the trails in the district converge to it. There was, however, a drawback to this, for these trails are sometimes used by the Indians, and it so happened that during the summer our cache was broken into by a band of marauders from the Grande prairie district, who made away with several articles belonging to the pack outfit, besides a large coil of sling ropes and some tools, which I presume they needed for building rafts across Big Smoky river, which they would have to cross at its highest stage of water. On June 8 we travelled westward on the Big Smoky river trail and came to Hay river, which had overflowed its banks and was running so swiftly that it was dangerous to attempt to cross here. So the next day we continued southwards along its right bank, and at half a mile above the fourteenth base line effected a crossing at a point where the river is quite wide and its bed free of boulders. The men were engaged one whole day (June 10) in cutting a road over the hills to the northeast corner of township 52, range 1, west of the sixth meridian, which was the point of commencement of my survey.

My instructions were to produce over the Rocky mountains the sixth meridian, which, in 1907, had been surveyed south to the northeast corner of township 52. The object of this survey, besides supplying data for future work, was to check the intersection of this meridian with the thirteenth base line, a point which has been located by a traverse survey beginning at the southeast corner of township 51, range 27, west of the fifth meridian (north side of the 13th correction line) and carried southwesterly along the foot of the mountains.

DESCRIPTION OF THE COUNTRY ADJOINING THE SIXTH MERIDIAN BETWEEN THE THIRTEENTH AND FOURTEENTH BASE LINES.

Between the fourteenth base and the point where the sixth meridian enters the Rocky mountains there are twelve miles of rough country made impassable for travel owing to the accumulation of fallen trees. To make any sort of progress required the help of every member of the party, the packers themselves frequently exploring for the best location of the road, and cutting the trail afterwards. There are several ranges of hills generally bearing east and west and covered with standing fire-killed trees. They have an altitude of 5,500 feet on the line, though some summits farther west are much higher. Between these hills, two streams, heading from glaciers, wind their course. The principal one called Hay river is two chains wide. Its banks are low and it meanders in a narrow valley from west to east across the centre of township 52, but shortly after crossing its eastern boundary it turns north. The other one is Solomon creek, in township 51. It receives numerous tributaries from the south and joins the Athabaska where it comes out of Brulé lake.

This country is not adapted for farming, even if the climatic conditions are favourable, which is very doubtful. At the present time it is thickly covered with deadfall, which prevent the growth of grass. Should, however, another fire overrun it, these would disappear and the exposed soil, aided by the copious rains which fall in this district during the early summer, would be covered with luxuriant vegetation, similar to the grazing lands found in some parts of the valleys of the Athabaska and Hay rivers. In the foothills south of Solomon creek I noted in section 25, township 51, a belt a mile wide of green timber (spruce ten inches to thirty inches, pine

ten inches to fifteen inches) growing on the northern slope of a high rocky ridge. Then comes one mile of fire-killed timber, followed by more green timber (pine twelve inches, spruce eighteen inches, balsam twelve inches) which decrease in size and quality as one ascends the side of the mountains. Finally in the middle of section 36, township 50, the timber line occurs at an altitude of 5,800 feet above the sea. From this point the line crosses one ridge after another, all connecting peaks nearly 8,000 feet high. These ridges are separated by deep chasms across which I had to make a triangulation to determine their relative positions on the line. Thus the survey was brought to the middle of section 24, when owing to the long and tiresome walks over deadfall and the stiff climbs we had to make, it was found impossible to make reasonable progress with the survey. In these mountains no pass exists through which we could bring the pack ponies, and the only alternative that presented itself was to send the outfit around the mountains, and try to reach again from the south the station which I had established at the present end of the line. Consequently on July 9, we returned to Solomon creek,, which we followed eastward to Brulé lake. Thence by following the valley of the Athabaska we came to Moose creek—the round trip occupying three days. We were still a long way from our destination. After exploring both sides of the valley of Moose creek, which I found obstructed by great quantities of fire-killed timber, I decided to follow the bed of this stream. All went well for the first day, but on the second we came to a canyon where further progress was prevented by numerous larger boulders and log jams. We had to climb out of this and managed to get to the edge of a plateau where for two days every available man in the party worked hard cutting a road for the pack train. After crossing innumerable deep gulches we reached again the same creek at a point one mile below the mouth of one of its northern tributaries. Its valley proved to be the right one to follow to the mountains where we had erected our last signal. From this point the sixth meridian was produced southward along the eastern slope of the mountains as far as the northeast corner of township 48. This line crosses Moose creek in section 36, township 49. West of this point, the valley proper of Moose creek is wider than at any other part of it which I have explored. Half a mile east of the line it becomes more confined as the hills on each side close in upon the creek leaving for its passage only a narrow gap between high rocky walls where the water rushes down for five miles. At the end of this canyon a dam could be easily built and the water thus held utilized for power. In the middle of section 25, the line intersects a deep ravine. Along the banks of a small stream which flows in it, I noticed a thin seam of coal.

South of section 25, the line passes through a brulé and for three miles ascends the eastern slope of the rugged mountains which rise west of the Athabaska. After crossing many deep gulches, it reaches the highest point above the valley, near the corner of section 1. Thence it descends to the wooded flats of the river which here divides into many channels.

In accordance with my instructions, I then went on with the survey of the sixth meridian, which I ran across the valley of Athabaska river. From the thirteenth base line I had to open the line through two miles and a half of pine and spruce woods. A heavy undergrowth covers the valley as far as the crossing at section 24. Stony river, a turbulent stream which, on emerging from the mountains into the gravel flats, divides into several channels by which it empties into the Athabaska. The land west of this is level but very stony. Half a mile south of Stony river the forest ends and we came to a prairie three-quarters of a mile wide, but extending less than half a mile on each side of the line. The soil is white clay and the subsoil gravel. South of this prairie a belt of green spruce six to twenty-four inches in diameter and pine six to fifteen inches in diameter extends to the north shore of Jasper lake in section 13.

This lake lies at a small angle to the meridian and where the line crosses it the width is over two miles and a half. Its length, however, must be nearly five miles and

its width would average one mile. Its west shore is abrupt and rocky; on the north and east sides, however, there is a fine sandy beach which extends to the head of the lake. East of Jasper lake from which it is separated by low sandy hills covered with jackpine, there is another narrow lake called by the natives 'Fish' lake. As it is fed by creeks and springs from the mountains its water is remarkably clear, unlike Jasper lake whose waters hold in suspension so much detrital matter continually brought in by Athabaska river that it remains muddy the greater part of the year.

Fish lake lies close to Jasper lake, into which it drains by a narrow and tortuous outlet. At this point the distance between the two lakes is but a few chains, but before reaching the open water in Fish lake one has to go a long distance through tall reeds. This growth of reeds and grasses, with the soft marshes which surround the lake, make it almost impossible to effect a landing anywhere without wading. Fish lake abounds with pike and whitefish.

Beyond this lake the line was surveyed to the quarter post on the east boundary of section 25, township 47, range 1, west of the sixth meridian.

As Jasper and Fish lakes extend across the whole width of the valley proper to the Athabaska there is consequently no bottom lands here for several miles. The hills which rise from the shores of these lakes merge into a series of benches, of which the highest is fully six hundred feet above the present level of the valley. The slopes of these hills are sometimes grassy but more frequently wooded with jackpine.

Level lands reappear again along the river and beyond the head of Jasper lake, but judging from the dense growth of small spruce, they must be swampy and also liable to be flooded at certain seasons. To avoid crossing these bottom lands, the Jasper trail makes a long detour to the west in the foothills.

Opposite the old Jasper house, there is another flat of half a mile between the right bank of the Athabaska and the foot of the mountains. It is covered with brush and willow and ends two miles farther south where the mountains approach Fish lake.

After the sixth meridian had been produced across Jasper lake, I found it necessary to cross the Athabaska once more so as to bring the camp closer to the work.

The packer had to swim the horses where the river issues from the lake, a bad crossing on account of the swift current which rushes among the sharp rocks which line the right bank. Some of the ponies which had parted from the bunch were swept down by the violence of the current amongst these rocks and landed with the greatest difficulty when the survey was completed, I did not care to attempt that crossing a second time, and although it took a day longer I went southwards along the shore of the lake and the river to a point opposite Moberly's ranch. Here we had to cross three wide channels before we came to the left bank. From August 10 we travelled in the valley of the Athabaska and after crossing that of Solomon creek arrived at our depot on the 18th.

Near the northeast corner of section 30, township 52, range 26, west of the fifth meridian, there is a trail which is always followed by the native hunters going from Prairie creek to the fur trading posts on Big Smoky river; at that point also there starts another trail, at present seldom used, which leads to the junction of Gregg creek, with Hay river on the north boundary of township 53, range 26; thence it goes by the valley of this river to that of Baptiste river. I decided to follow that route to get to the fifteenth base line which I had been instructed to survey westwards from the northeast corner of section 34, range 20, where Mr. Saunders had quit work in 1905. The distance between our depot and the mouth of Gregg creek is ten miles by the trail, which, not having been travelled for years, required some heavy chopping through windfall before it was made passable for the ponies. To avoid the marshes at the lower end of Gregg lake and its outlet, this trail cuts across the hill for five miles. It then enters a level country with patches of prairie surrounded by scrub, willow and small timber, which would be easily cleared. The soil is a yellow clay

which grows bunch grass in great profusion, but owing to the altitude of the country (3,700 feet above the sea) it is doubtful if crops could be raised. It would, however, be a good grazing country, though of limited extent.

During my stay in the mountains in the early part of the season, several of the pack ponies had suffered from a contagious disease which had left them in a weakened condition. Fearing to lose any if I worked them too hard, I decided to load on rafts the bulky part of the outfit, including the iron posts required for the survey of the fifteenth base, and to send the horses with light loads by the valley of Hay river.

On August 21 we began our voyage on the river. As its navigation was unknown to us, I resolved to keep ahead of the party with the small canvas boat in which I had placed my instruments. The packer was also instructed to bring the pack train by this valley and I left to help him on this trip a man who, the year before, had passed several times through the valley and so became acquainted with the different fords on the river and the country best suited for travel on either side, for in case of the loss of the outfit through accidents which are always possible when navigating these tortuous and swift streams, we could have been joined by the pack train which would never be very far behind. On the first day out on the river, the heavily loaded rafts frequently ran aground on the bars but were always brought into the deepest channels which the men soon learned to pick out. In the middle of the day we went over a rapid full of large boulders which could not all be avoided and on which the rafts stuck fast. As I had them built sufficiently strong to meet such obstacles they came out of it without anything having given way though it took considerable time and some hard work to extricate them from their dangerous position. These difficulties disappeared as we proceeded down, the volume of water in Hay river being gradually increased by its many western affluents. The first important one noticed flows out of a canyon joining the river about two miles south of the fourteenth correction line. In this vicinity the valley narrows to a quarter of a mile and from each side rise high sandstone cliffs. Then comes an interval of several miles where from the banks of the river, large flats extend half a mile to the foot of the hills. A few of these flats are in prairie or hay meadows, but the majority support a heavy growth of merchantable timber.

The largest western branch of Hay river was passed in township 56, range 24. It is the same stream which at twenty miles farther west crosses the sixth meridian. Two miles below its mouth the river turns more to the east for four miles, and after receiving two smaller streams which rise on the highlands west of Athabaska river, flows again in a general northerly direction until it meets Baptiste river.

On August 25, we were within a mile and a half of the fifteenth base line, waiting for the packers who did not return to our camp before August 30; instead of coming by the flats along Hay river, as they had been instructed, they ventured with the pack train on old hunting trails which led nowhere in particular. Afterwards in order to extricate themselves from the impassable deadfall which covers the whole country, they had to cut several miles of road to enable them to reach the valley of the river again. On that trip some of the horses played out and others were brought in in a pitiful condition. Thus delayed it was only on September 1 that we got to the place where the base line intersects the valley of Hay river. Two days later we reached the Athabaska.

I had noted that the whole country east of the river was heavily timbered and concluded that no pasture would be found there except perhaps at distant intervals, which proved to be the case. Accordingly I had the sick horses driven to some hay meadows west of the river and left them in charge of one man. Taking those that were able to carry loads I continued my voyage eastward and on the 11th reached the line and began its survey at the northeast corner of section 34 township 56 range 20.

In going from Hay river to range 20 the road has been cut as near the base line as the topography of the country permitted; we thus knew of the few spots where feed

could be found for the ponies. It was also a great help to us when engaged in the survey, for men whom otherwise I would have had to send to explore and cut this trail, were employed at mounding, and chopping on the line.

On September 11, we pitched camp at a mile and a half west of the corner of section 34, township 56, range 20, and on the next day I began the survey of the fifteenth base line.

On October 7, the pack ponies were brought back to camp from the valley of Hay river, where they had been kept till the survey of the line had been completed to range 25. Though it was late in the afternoon when the packer arrived, we had to move because there was no pasture for miles around on the high lands where we had been camped; but the main reason was that nearly the whole party had started afoot several hours before, improving as they went the road which we had to follow, in the direction of our next camp. As it would never do to disappoint them, we had, on account of a late start, to travel part of the night till we caught up to them. They had gone as far as the river, which they had not been able to cross, and as it was pitch dark when we reached that place with the pack train, we had to stay there till morning.

On this trip we followed the valley of Hay river, made good progress, and always found good pasture for the ponies, when time came to stop for the night. We arrived at Gregg lake on October 11, and two days later camped at the mouth of Prairie creek. At Gregg's store I took supplies for three weeks, which is the time it generally takes to cover the distance between the mountains and Lake St. Ann settlement. I also took ten bags of oats, which had been left there by Mr. A. H. Hawkins, D.L.S., who kindly authorized me to do so. As it was late in the season the grass along the road would necessarily be scanty, but with this grain I expected to bring all my ponies safely as far as Sinclair ranch (Big eddy) where I could get oats which I had stored there in the spring.

We left Prairie creek on the 14th and went by the old Jasper trail to Trail creek, where we turned east. In crossing the divide of the McLeod, we were overtaken by a heavy storm, but this did not prevent us from continuing our journey till we got down in the valley of the McLeod. On the following days we passed several new buildings, put up by parties who have taken land in the most favourable spots along this river. The land where it has been ploughed shows a black sandy loam, which ought to grow all kinds of crops. It remains, however, to see how the climate will affect these as the altitude of the river flats is 3,600 feet above the sea.

One man who owns a timber limit near the headwaters of the McLeod has taken up land also one mile above The Leavings, where he proposes to erect a sawmill.

On October 19 we arrived at 'Big eddy,' in another snowstorm, which left the ground covered with eight inches of snow. On October 22, the storm having abated, we left for Lobstick river, taking a road different from the one followed in the spring. This change was made necessary to enable us to procure from the settlers along the route hay for the ponies, which could not subsist on the dried slough grass.

After leaving Sinclair's ranch we followed the left bank of the McLeod for two days, crossing to the opposite bank near the mouth of Muskeg river. Two miles below is Smith's ranch, where I decided to camp, because it was the last place where it would be possible to buy hay for the ponies. From Smith's ranch the trail runs along the right bank of the McLeod for eight miles more; then it turns easterly and leads to Goose Grass encampment, which is as far as the right of way of the Grand Trunk Pacific has been cleared this fall. For four days longer we travelled on this road, arriving at Chip lake on the night of October 27. The grading done through this district by the Grand Trunk Pacific ends near the point where Little Lobstick river empties into Chip lake.

On October 29 we arrived at Pembina river, partly frozen over from both sides, except for a channel in mid-stream, carrying much floating ice which had jammed a

short distance below the landing. Fearing to be delayed here for several days by the complete blocking of the river, as this might easily happen at that season, I immediately sent the ponies across the stream, where there chanced to be some hay which I bought from F. W. Thompson, a resident of the place and the owner of a large living tent in which he allowed us to spend the night.

The next morning it took several trips with a strongly built boat able to stand the pressure of the ice, before the outfit had been safely brought across the river, when we continued our journey to MacDonald's ranch, fifteen miles east of Pembina crossing.

The three men I had left to help the packer with his work returned later on with one horse that had played out on the road.

From Mr. MacDonald I hired three rigs and proceeded to Lake St. Ann settlement on November 2. The ponies were driven to Ray and left at Mr. Angus McDonell's farm, as I had been instructed to do. That evening I met Mr. McDonell at St. Albert and informed him that the horses were at his ranch. Later on he returned to Edmonton and signed a contract for the keeping of these ponies till they are required again.

GAME.

While surveying the sixth meridian across the mountains, goats were seen, and judging from their well beaten paths they appear to be in great numbers. Some of these paths were followed at times, and they invariably proved very useful in leading us around precipitous and deep gorges which lay undetected across our way, and where we would often have been delayed.

In the valleys of Hay river and Solomon creek and those leading to them, the moose roam and the Indians who depend on this game for their supply of meat must often run across them as shown by the stagings erected at frequent intervals for drying the meat.

This country produces a great variety of berries; bears who subsist mostly on these during the summer are quite common. Small game and water-fowl are scarce, only a few ptarmigan or 'white partridge' having been seen in the lowlands.

Beavers are increasing in this district. The freshly cut poplar trees on the banks of Athabaska and Hay rivers show that they are now returning to these streams, while on all the creeks east of Athabaska valley I saw at short intervals several newly built beaver dams, replacing old ones which had been broken by the native hunters. Their well beaten roads leading to these dams would indicate that many of them are at work here.

There is splended trout fishing in the larger streams, and whitefish can be caught with nets in all the lakes. Pike is also caught in a few of these lakes, but they are more plentiful in the streams where the current is sluggish and the beds covered with aquatic plants.

I have the honour to be, sir,
Your obedient servant,

A. SAINT CYR, D.L.S.

APPENDIX No. 41.

REPORT OF J. B. SAINT CYR, D.L.S.

SURVEY OF SETTLEMENTS, TOWNSHIPS AND OUTLINES IN THE PEACE RIVER DISTRICT.

MONTREAL, February 1, 1909.

E. DEVILLE, Esq., LL.D.,
Surveyor General,
Ottawa.

SIR,—I have the honour to submit the following general report of my field operations during the past season in the Peace river district.

In accordance with your instructions dated May 1, 1908, I left Montreal on the 12th and reached Edmonton on the 17th. After a few days spent in Edmonton to hire men and make arrangements for the trip I started north on May 23. On the 29th we left Athabaska Landing on board of the Str. 'Midnight Sun,' making connection with the Str. 'Northern Light,' on the Slave river. We arrived at Slave Lake settlement on June 5. On my arrival there I bought three teams of horses, wagons, harness, &c., to complete my outfit, and on June 6, I started for Peace River crossing, where I arrived on the 10th. The water in Peace river was very high and the current quite swift, carrying even trees and logs down stream. As the ferry was crossing the river, the roots of a floating tree caught it, breaking the ropes that held it to the cables and it was carried down stream a long distance near a high cut bank on the opposite shore. As it was very risky to cross my outfit on the Hudson's Bay company's little ferry, with that state of water, for a few days at least, I completed the survey of the settlement commenced last year.

On June 15 I succeeded in crossing my outfit on the little row ferry and the next day I was travelling towards Dunvegan. I arrived at the twenty-first base line on the 18th, and the next day I began the resurvey of that line across ranges 3 and 4 west of the sixth meridian, after which I started the subdivision of townships 80, ranges 3 and 4; this subdivision was completed on September 18. All the monuments on the original base have been destroyed and other monuments have been erected on the correct base. The land subdivided has a very fine aspect, the surface being prairie and bluffs, and the soil is very good. The country is generally level or undulating with the exception of the land adjoining Peace river, Muddy creek and Boucher creek, where it is broken and hilly. Hay is plentiful all through that country and spruce for building or fencing purposes can be procured almost everywhere. Fuel is plentiful also. The different streams draining that country furnish a large quantity of good water in the spring. With very little work the settlers could dam those creeks in different places and have a good supply of water all the year round. I believe also that water can be found by boring deep enough. The Peace River crossing and Dunvegan wagon road, and the Green island road cross those two townships from north to south.

Having completed the subdivision of those townships, the traverse of Peace river and the survey of a few lots at Dunvegan, I afterwards ran the east boundary of township 79, range 5 west of the sixth meridian as far as the correction line. The surface is prairie and bluffs. The soil is a black loam varying in depth from four to six inches and overlying a clay subsoil. This open country extends about two miles to the east of the line, and a long distance west of it. Dunvegan and Spirit river wagon road passes

west of the line and crosses the country in a southwesterly direction. About the end of September I went to township 78, range 3, to complete the mounding left in the fall of 1907, and while there I surveyed the south boundary of township 79, range 3. This township is thickly timbered with poplar, spruce and large willow; the soil is very good and the country level with the exception of sections 1 to 6 in the vicinity of Spirit river and Brulé river where the land is broken and hilly. There are a few scattered sloughs in that township but no prairie. The slope of the hills bordering the south shore of Peace river, north of that township, is thickly timbered with spruce varying from ten to eighteen inches in diameter and suitable for lumbering purposes.

On October 18 I started for the twentieth base line. Having established my camp where Brulé river crosses the Grande prairie road, I began the survey of the east boundary of townships 77, and 78, range 5. This line was completed to the correction line on November 26. Of all the country west of that line, nearly the whole of township 78 and the north one-third of township 77 is prairie and bluffs. The remaining part of this last township is thickly timbered with poplar, spruce and large willow. I also proceeded to survey the north boundary of township 78, range 4, west of the sixth meridian which I completed on December 7. Nearly half of the township is prairie and bluffs, and the soil is very good; it is a black loam from four to eight inches in depth resting on a clay subsoil. The eastern half of the township is timbered with poplar, spruce and large willow. The country is undulating in the east, and rolling towards the west boundary of the township.

The soil in that country situated between Dunvegan, Spirit river and the twentieth base line contains a certain amount of moisture rendering it very suitable for farming purposes. Though water appears to be scarce in some portions of Spirit river prairie, I believe that water can be procured by boring deep enough. The settlers living along Spirit river have constructed dams in different points and have a good supply of water for summer and winter. Springs exist on the sidehills of the many ravines crossing this country, proving that there is some water in the ground.

The settlers of this country have succeeded well in farming, ranching and gardening. The crops of the last two years have been very encouraging to them and indicate a good prospect for the future of that northern country. Messrs. English and Calkin of Spirit River had last fall a crop of about three thousand bushels of oats and wheat, heavy and hard grain well ripened. Ranchers are doing well in that district, having no difficulty in procuring hay; the prairie is also a very rich pasture. There is generally no early frost to injure the crop. When this country is cultivated to a larger extent the heat of the summer days penetrating the soil will keep the frost at a distance during the night. The snow is never very deep in the winter and horses and cattle may be seen on the prairie all the year round. The chinook wind blows often over the country, thawing all the snow in a couple of days. The temperature is fine and mild in the fall, in the first part of the winter and in the spring. There are none of those strong winds blowing for weeks as in some other parts of the territory. Communication is getting easier every year; the roads have been improved lately and bridges built on different points of the trail. There are two steamers making the service from Athabaska Landing to the upper end of Lesser Slave lake, the Str. 'Midnight Sun,' on Athabaska river, and the Str. 'Northern Light,' on Little Slave river and on Lesser Slave lake. Those steamers belong to the Northern Transportation company. The trip from Athabaska Landing to Lesser Slave lake is made in four or five days at the most. There is a cable ferry at Peace River crossing and there will be one also at Dunvegan next summer according to reports. The wagon road to 'Grande prairie' was also worked last summer. Without doubt the Peace river district has a great future and the country is so vast and the soil and the climate so good that settlers will find there nearly everything to meet their requirements.

Having completed the survey of the outlines of townships 77 and 78, range 4, and townships 79, ranges 3 and 5, on December 7, I started for Edmonton. As it was

impossible to cross my outfit at Dunvegan for several weeks, I decided to travel by the winter road passing at Egg lake, crossing Smoky river and Winagami lake. On December 18, I arrived at Lesser Slave lake, where I left my outfit, making arrangements for the wintering of the horses, and started immediately afterwards for Edmonton. The second day after my arrival at Edmonton I started east and arrived in Montreal on December 31.

I have the honour to be, sir,
Your obedient servant

J. B. SAINT CYR, D.L.S.

APPENDIX No. 42.

REPORT OF B. J. SAUNDERS, D.L.S.

SURVEY OF PART OF THE ELEVENTH BASE LINE WEST OF THE FIFTH MERIDIAN

GENOA, February 2, 1909.

E. DEVILLE, Esq., LL.D.,
Surveyor General,
Ottawa.

SIR.—I have the honour to submit the following report on the survey of the eleventh base line. west of range 8, west of the fifth meridian, surveyed under your instructions, dated March 5, 1908.

Having organized my party at Edmonton on April 21, we proceeded to Lacombe by rail, and from that point by the main road and trail to Saskatchewan river at Rocky Mountain House. The trail was found even at that early season in a very wet condition, and we could carry only very light loads. Lumber was taken from Lacombe, from which a boat was constructed to assist in crossing the Saskatchewan with our supplies, there being no ferry in operation at the time. One was subsequently built by the provincial government of Alberta and made ready for traffic early in July. This ferry is situated about two miles down stream from the old Hudson's Bay company fort at Rocky Mountain House.

We reached the northeast corner of township 40, range 8, west of the fifth meridian, with the camp on May 5, and after observing for time and azimuth the work of producing the line westerly was duly commenced and carried on almost continuously until December 1, by which time it was surveyed to range 19 west of the fifth meridian.

During the early part of the season, and, in fact till the middle of July, the weather conditions were most unfavourable for rapid work on account of the heavy and almost continuous rainfall.

Throughout ranges 8, 9, 10 and 11 the line traverses a country fairly open in places, especially along the streams, and where there is not much timber fairly good grazing is found for horses. The south branch of Baptiste river crosses the line three times in ranges 10 and 11 and joins the north branch of the same stream about three or four miles to the north of the line in range 10. Grasses grow most luxuriantly along this stream. In ranges 8 and 9 quite a number of small muskegs were met with, but the greater part of these could be drained easily with the opening up of the country. The watershed throughout the first three ranges is very narrow between Saskatchewan and Baptiste rivers, and the land is generally rolling in character.

In ranges 12, 13 and 14 higher country with much burnt and fallen timber was encountered, rendering it necessary to make a detour to the south to the Saskatchewan river to find a practicable route to move camp on. The outer range of the mountains was crossed in the first mile in range 15. The general direction of these mountains is northwesterly and southeasterly; close to the crossing of the line they reach an elevation of about 7,300 feet above sea-level, as determined by aneroid barometer.

Ranges 15, 16 and 17 consist of very hilly country. The Bighorn range of the mountains was crossed by the line in the westerly part of range 17 at an elevation of about 8,225 feet above sea-level as determined by aneroid; the watershed between Saskatchewan and Brazeau rivers lies near the centre of range 16. The easterly part of range 18 is very mountainous and practically impassable. The chainage was carried over this portion of the line as well as the westerly portion of range 17 by triangulation. The westerly portion of range 18 consists of rolling country, fairly well timbered, with open areas along the stream now known as Little Brazeau river.

The line was extended one mile and a half into range 19 and practically up to the foot of the next range of snow-capped mountains. At a favourable season of the year it could probably be produced a mile or two farther without much difficulty.

Generally speaking, the soil traversed by this base line is of good quality and varies from sandy loam to a clay loam, with more or less sandstone and limestone in the westerly ranges. In range 9 some fairly good merchantable spruce timber is found. There are also some very good patches of spruce and pitch pine at different points along the line in ranges 15, 16 and 17, all of which are quite accessible to streams flowing either to the Saskatchewan or Brazeau. In all other parts there is an abundance of timber consisting of poplar, pitch-pine, spruce and some tamarack suitable for building purposes.

Outcroppings of lignite were noticed in section 6, township 41, range 11. Large seams of the much sought for Brazeau coal are found on section 34, township 40, range 18. These were connected by survey to the base line.

In Baptiste river, Mire creek and Little Brazeau speckled trout of excellent quality are found in great numbers. Many moose and jumping deer were seen throughout the whole season.

The country is one of the best watered that I have met with in twenty-five years experience in the field, and should be well adapted for stock raising in limited numbers as far west as range 15.

Some eight or ten families of settlers have already located on Saskatchewan river in the vicinity of Rocky Mountain House in townships 39, ranges 7 and 8; they seem to be doing well and are well satisfied with their prospects; they are engaged in stock raising and have grown some grain. Vegetables ripened last year without any injury from frost. Along Saskatchewan river as far west as range 13 there are some excellent hay flats where the native grasses grow to a height of almost three feet.

The section of the country traversed by this base line can be reached by road and trail from either Lacombe, Red Deer or Innisfail by way of Rocky Mountain House. From Rocky Mountain House westerly there is a fair wagon road along the north side of Saskatchewan river for about twelve miles; it then swings north to the Baptiste, down which stream wagons have been taken fifteen or twenty miles. With my party I had a road cut up the south branch of this stream and beyond for a distance of about twenty-five miles for the purpose of taking in supplies by wagon; the end of this road is quite close to Saskatchewan river in township 40, range 12. From this point on, pack horses had to be used exclusively. The western portion of this base line can be reached by pack trails from either Morley, Banff or Laggan.

In my opinion there are no very great physical difficulties to be encountered in building a railway line via Rocky Mountain House to the Brazeau coal fields from either Lacombe, Red Deer or Innisfail, or even from Edmonton or Strathcona, striking the coal areas almost direct from either of those points. Such a line would open up a good country and at a very early date give the whole country along the Calgary and Edmonton branch of the Canadian Pacific railway access to coal fields where coal of excellent quality for manufacturing and domestic purposes is found.

The member of my party engaged in exploring the country on either side of the line did good work in determining its physical characteristics. The results of his works are shown graphically on a sketch plan accompanying this report.

A line of levels was run along the base to the end of the work. These levels were carried over the Bighorn range trigonometrically. They are reduced to a datum determined by a series of barometric readings taken at the northeast corner of township 40, range 11, west of the fifth meridian, and were carried back to Saskatchewan river in range 7. Permanent bench marks were established at about half-mile intervals along the line and at the waters edge of Saskatchewan river. Connection to any of these bench marks by a line of levels reduced to sea-level can be made at a future time, and thus a profile with correct elevations of the whole base line can be prepared.

I have the honour to be, Sir,
Your obedient servant,

B. J. SAUNDERS, D.L.S.

APPENDIX No. 43.

REPORT OF H. W. SELBY, D. L. S.

SURVEYS IN LESSER SLAVE LAKE DISTRICT.

TORONTO, February 2, 1909.

E. DEVILLE, Esq., LL.D.,
Surveyor General,
Ottawa.

SIR,—I have the honour to submit the following general report on the survey of township outlines and the subdivision of lands situated in and near the Lesser Slave lake district, performed under your instructions dated February 7 and March 6, 1908.

Leaving Toronto on March 10, I proceeded to Edmonton, organized my party and transport equipment, and on the 20th left for Lesser Slave lake. Contrary to previous years the roads were very heavy with drifting snow, and this delayed our arrival at 'Little prairie,' where my work was to begin, until April 8. 'Little prairie' is on the Peace river road about sixty miles northwest of Lesser Slave lake. The snow was still about a foot deep in the woods, and there was no feed for the horses near the end of the twenty-first base line. I was instructed to continue the base line east, across ranges 20 and 19 from the northeast corner of range 21, and subdivide the land in those ranges suitable for settlement. The camp was placed where hay could be got near Bearhead creek, and a road cut westerly to within a mile of the point of commencement, over which the party was driven to and from work while running the base line and subdividing the east half of township 81, range 20, south of Heart river. The melting of the snow during the time this work was being done made it very troublesome. The country being nearly level and the ground deeply frozen, the water lay on the ground to the depth of several inches until after the middle of May. Very little mounding could be done except to clear the ground of logs and brush and mark out the pits, taking off the top soil where possible and letting in the warm air to thaw the ground. In August I sent two men to complete the mounding. The lands suitable for settlement within the near future, are situated in the east half of township 81, range 20, west half of township 81, range 19, and part of the northeast corner of township 80, range 19. These were subdivided. The Peace river road cuts these lands from southeast to northwest, through a strip of prairie from half a mile to a mile in width. The soil is a rich black loam on clay subsoil, and is covered with an abundant growth of upland hay. This prairie is suitable for farming purposes, but at present it is used entirely for grazing and for the hay grown upon it by the half dozen squatters who live there. The timber on the remainder of the subdivided land is chiefly small poplar and willow brush. There is very little waste land in those surveyed, and when it has been demonstrated that grain can be grown there profitably, and being on the leading highway through this country, it should soon be settled by a good class of homesteaders. Until the past year no white settlers had located on these lands, but three white settlers have begun to make improvements and had sown a few acres of grain as an experiment. This looked very well when I last saw it, but there is not likely to be much grain grown until railway facilities are secured.

My assistant Mr. W. A. Scott arrived on June 3, having been on the road since May 4. He was at once instructed in his duties. After ascertaining his capabilities, and his desire to gain all the experience possible, I placed him in charge of the transit under my personal supervision and it is with great pleasure I record my appreciation of his services and his willing, energetic and careful fulfilment of the duties assigned to him.

This part of your instructions having been carried out, on June 10 we began our return to Lesser Slave lake, where I made a retracement survey and some other measurements in the settlement, required by you. The water in the rivers and lake being very high, on the 17th I sent the horses around the lake and shipped the supplies and outfit by boat to Swan river, where we were met by the teams, and camp taken to Mr. Hunt's near the northeast corner of township 72, range 10. At this time of the year the water from the hills causes the river to rise to such a height as to make the fords impassable except by boat. The Alberta government have since built a bridge one thousand one hundred feet long across the outlet of Buffalo bay at the west end of Lesser Slave lake, and I got the Indians to help build a bridge over a bad slough, one hundred feet wide, about one mile east of the east boundary of township 73, range 12, where several teams have been drowned, and many narrowly escaped the past season. Driftpile river, at times is twelve feet deep and two chains wide, and there should be a bridge built, to give the settlers at Swan river an outlet for their mail and to obtain their supplies. Of course at low water the ford is good and quite safe, but I have seen the water rise five feet in two hours as the result of a shower of rain. The water at the mouth of Sucker creek and Little Sucker creek is always at the level of the lake and with a good bottom of hard sand is always safe though the water sometimes is deep enough to come into the wagon box and damage goods. When these obstacles are overcome the road to Swan river will be a good one.

Up to this time there was not grass enough on the Peace river road for working horses to live upon, but when they got to Swan river prairie it was from nine inches to twelve inches high. The improved condition of the Peace river road was very noticeable and whereas in 1904 a load of one thousand two hundred pounds was enough and sometimes too much, this year the freighters were taking from two to three thousand pounds at a time. My work at Swan river was to subdivide such portions of the country as were suitable for farming purposes in the near future. I found upon examination that parts of townships 72, ranges 9 and 10 and townships 73 and 74, range 10, being the lands drained by Swan river, would take in all that was contemplated by my instructions. A detailed description of these townships is entered in the field notes.

Swan river rises among the hills about thirty miles to the south and flows northerly between high ranges of hills, to the south boundary of township 72, range 9 in section 5, where the country becomes almost level. About half a mile north of this point, Swan creek, a branch of the river, joins the main stream, flowing from the southeast among the hills, which it appears to cut in two. About at right angles to this stream a range of hills extends northeasterly towards the lake. These hills as seen from the distance appear to be heavily timbered with poplar and spruce. The range of hills continues west of Swan river for at least six ranges, and through them at intervals, various streams flow into the lake, forming points at their outlet. This action has apparently been going on for ages, and has formed these lower levels of alluvial lands such as are seen at the mouth of the Swan and Driftpile rivers. What is known as the Swan river prairie extends northerly from Swan creek in section 8, township 72, range 9 on both sides of Swan river from a half mile to a mile in width into section 6, township 74, range 9. At the time of survey there were six settlers, with improvements at different points on the river. Small patches of prairie are found through the other surveyed lands, and the timber is chiefly light poplar and willow. Large meadows suitable for grazing purposes are found on the west half of townships 73 and 74, range 10, but they are at present too rough and have too much brush on them for hay making, but they can be easily cleared and drained.

Railway facilities will make the Swan river country one of the most favoured settlements of the West. Its close proximity to mining prospects, considerable areas of spruce and poplar, good soil, plenty of fuel, good water and excellent climate caused by the almost universal east or west winds, leads one to this optimistic view. Mixed farming will be the most productive of good results here as in all other portions of the West, where frost is liable to occur.

In addition to the road following the lake shore mentioned before, there is a very good wagon road from the north end of township 74, range 10, to Swan creek and a few settlers cut a wagon trail over the hills from the Athabaska river to this road this season.

The next work to be done was to run the east outlines of townships 73, ranges 12 and 13, to ascertain the quality of the soil and where the valuable timber areas were, together with the possibility of the land being required for immediate settlement.

Townships 73, ranges 11, 12 and 13, are quite rolling, with a descent from the south towards the lake. The highest parts are heavily timbered with poplar and scattered spruce and have a stony clay soil, while those near the lake shore, except along the banks of Driftpile river and the greater part of the Indian reserve, are composed of swamp and muskeg, covered with small spruce and willow, and adjoining the south-east boundaries of the Indian reserve, are especially very wet, while only for short periods and in occasional seasons can stock graze on these lands. What is known as the Driftpile Indian reserve in the north end of township 73, range 12, is laid out along the banks of Driftpile river, and contains some of the best land on the south shore of the lake. This is occupied by a few Indians who live chiefly on fish and game, only two or three making any attempt to grow anything for themselves or their stock. I would not advise the subdivision of these lands adjacent to the Indian reserve for the present, as there is not enough of good farming land to make a settlement.

Broken township 74, range 13 was subdivided as it is on one of the few portions of the Lesser Slave lake shore where there is water deep enough for steamboats to land. It was thought also that when a railway is built that this would be an objective point on the lake and an important station on the railway. One stone building had been built before survey was made. These surveys completed all that was thought necessary at present to be done here, so on October 8, I took my outfit by steamer to the east end of the lake where the village of Sawridge has begun to grow. At present it consists of two stores, livery barn, postoffice, stopping places, church and a few log houses. Around this village I subdivided the south two-thirds of township 73, range 5, and small portions of townships 72, ranges 5 and 6, two sections of township 73, range 6 and four sections of township 73, range 4. Throughout this territory there are small prairie spots, on some of which settlers have begun to make improvements. Adjoining the northwest corner of this surveyed land in township 73, range 5 there is a nice bunch of spruce timber of probably two or three million feet. This land should not be subdivided at present. Having stored the transport outfit in care of the Mounted Police at the east end of Lesser Slave lake on November 28, the ice being good on the river, we started for Edmonton, but on account of the wing dam being built to hold the water back we left the ice at Moose river and travelled overland to Athabaska river. This was frozen over except a channel of two hundred feet which was running full of ice. There was nothing for it but to build a raft; as timber could be got about half a mile away, we went to work and by three o'clock in the afternoon we had three teams sleighs and baggage across. If we had gone over the road on the east side of the river to Athabaska Landing, we should have been blocked from crossing for several days for the ferry had been hauled up out of the river. We arrived at Edmonton on December 5, where I paid off the party, and after attending to necessary details left for home on the 19th.

In conclusion, I wish to record my appreciation of the services of my assistant Mr. W. A. Scott, and the other members of my party who always performed their work with willingness, cheerfulness and diligence.

I have the honour to be, Sir,
Your obedient servant,

HENRY W. SELBY, D.L.S.

APPENDIX No. 44.

REPORT OF A. C. TALBOT, D.L.S.

SURVEYS AT LAKE LOUISE AND LAKE MINNEWANKA.

CALGARY, ALTA., November 12,1908.

E. DEVILLE, Esq., LL.D.,
Surveyor General,
Ottawa.

SIR,—I have the honour to submit the following report on the work done by me, during the months of August and September last at lake Minnewanka and lake Louise.

In compliance with your instructions of June and July, I communicated with Mr. H. Douglas, Commissioner of Dominion Parks and met him by appointment, at Banff, on July 7, to find what surveys were required at Minnewanka and at lake Louise. I went over the ground with him at Minnewanka, where after a careful examination of the place we decided to ask you for the cancellation of part of the old survey, to give us a free hand to make a new survey of villa lots, more suited to the nature of the ground.

Having received final instructions on August 8, I left Calgary on the 12th and arrived at Minnewanka the following day. I was there for eight working days of which about five only were employed on the Minnewanka survey.

I took upon myself to give a day's work to an official of the Department of Marine and Fisheries to find levels from a small lake near Minnewanka, (used as a fish nursery), to a point on Devil creek. I suggested writing to the Department for authority to do the work, but there was no time for that as the work was wanted immediately, and there was no one else to do it.

I had an accident with my transit on the morning of the 20th, and had to express it to Winnipeg for repairs. I went down to Calgary for another one to continue the survey.

The work was completed at Minnewanka on August 22 and I left immediately for lake Louise, where I arrived during the evening of the same day.

I started work on the Laggan and lake Louise survey, by locating the old surveyed line, east boundary of section 32, township 28, range, 16, west of the fifth meridian and re-opening part of it; I then produced it south, to the northeast corner of section 20, thence west, along the north boundary of section 20, to the northwest corner.

When the section lines had been surveyed far enough to locate the Canadian Pacific railway chalet and other buildings at the lake, I asked Mr. Douglas, Commissioner of Dominion Parks, to come to the lake to give his opinion as to where the road should be surveyed near the chalet and the frontage to be allowed to the Canadian Pacific Railway company.

As the company had already spent a large sum of money improving the ground in front of the chalet, filling up and terracing, and was opposed to the opening of a public road there, Mr. Douglas agreed to have it surveyed on the face of the hill, back of the chalet. When this had been surveyed, I found that the turn in the road, near the villa lots came too close to the chalet and would interfere with the proposed building of an addition, one hundred and seventy-five feet long to the west of the present building, Mr. Hayter Reed, representing the Canadian Pacific Railway

company, who happened to come to the lake at that time, objected very strongly to the piece of road near the villa lots and also to the piece between the buildings back of the chalet, although it had been accepted by Mr. P. J. O'Leary, another official of the company, who had discussed the matter with Mr. Douglas.

I thought Mr. Reed's objections were justified, because, if the public has to go back of the chalet to reach the west shore of the lake, it matters very little whether the road is back of all the buildings or through them as at first proposed, but it is quite different with the owners of these buildings. For these reasons I made an examination of the place, and having found just as good ground, if not better, to build a road, back of the buildings, I decided to make the change. I would have preferred to consult Mr. Douglas before doing so, but he was absent from Banff at the time and I could not wait for his return.

At the request of Mr. Douglas I surveyed a block of six villa lots, on the lake shore west of the Canadian Pacific railway grounds and another block of seven lots east of Louise creek. The belt of land between the surveyed road and the north boundary of section 20 was also surveyed in larger lots, as I was informed that part of this would be leased in the near future.

The railway company, having some work along Louise creek and a power house for their electric plant, in the southwest corner of section 28, wanted to secure that corner of the section, so I surveyed ten acres for that purpose.

The west end of the north boundary of section 19, was over very rough ground and as I had already a good check on the survey made, I decided not to open that line. Another reason was that the work had taken more time than was expected and I did not want to prolong it more than was absolutely necessary.

GENERAL INFORMATION.

Forest fires have killed a large quantity of timber along the valley of Bow river. Opposite Laggan these fires ran about half way to lake Louise, some years ago; this track is now covered with a new growth of pine, with a large quantity of the dead timber standing up, sound and clear of bark. From the burned belt south, up to a height of about 1,500 feet above the valley of the river, there is a belt of good green timber, principally spruce, pine and fir; trees are generally very tall but not of large diameter, a few only being over eighteen inches.

The soil between lake Louise and Bow river is mostly of glacial formation, composed of boulders of all sizes mixed with coarse sand and gravel. It was impossible to plant posts in most places and the digging of pits was out of the question, even in open places; the only way of marking corners in a permanent manner was to build a stone mound around the post to hold it in place.

The weather was very wet part of the time I was at lake Louise and the progress of my survey was consequently retarded. Another cause of delay, was the small number of labourers at my service to do the bush work, five at the most, and of these, two only were fairly good axemen.

The survey at lake Louise was completed on September 18, and I returned to Calgary on the following day.

I have the honour to be, sir,
Your obedient servant,

A. C. TALBOT, D.L.S.

APPENDIX No. 45.

REPORT OF W. THIBAUDEAU, C.E.

INVESTIGATION OF WATER-POWERS ON STREAMS IN SOUTHWESTERN ALBERTA.

E. DEVILLE, Esq., LL.D.,
Surveyor General,
Ottawa.

OTTAWA, April 30, 1909.

SIR,—I have the honour to submit the following report of my field operations during the past season, under your instructions, dated July 11, 1908, to investigate the water-powers on the rivers flowing from the eastern slope of the Rocky mountains in Southern Alberta.

I left Ottawa on July 16 and proceeded to Calgary, where I interviewed Mr. Stewart, Commissioner, at the Canadian Irrigation Survey office, with the object of securing data *re* the flow of water in the various rivers which I contemplated investigating Having secured certain data, I made the following preliminary exploration:—

1. St. Mary river, from its mouth to the international boundary, approximately one hundred and ten miles.

2. Belly river, from its confluence with St. Mary river to the international boundary, approximately ninety miles.

3. Waterton river, from its confluence with Belly river to the international boundary, approximately sixty miles.

4. Lee creek, a tributary of St. Mary river, from its confluence to about seven miles up stream.

5. Tib creek, a tributary of Belly river, from its confluence to about five miles up stream, or about one mile above the forks.

6. Blakiston brook (Pass creek), a tributary of Waterton river, from its mouth to about five miles up stream.

7. Oil creek, a tributary of Waterton river, from its mouth to about two and one-half miles up stream.

8. Pincher creek, a tributary of Oldman river, from its mouth to about two miles above Pincher Creek townsite, a distance of seven miles.

9. Mill creek, a tributary of Southfork river, from its mouth to about three miles up stream.

10. Southfork river, from Mill creek to about two miles above the forks on both branches, or about eight miles.

11. Crowsnest river, from Cowley to Coleman, or about twenty-three miles.

12. Gold creek, tributary to Southfork river, from its mouth to Lille, about five miles.

13. Blairmore creek, from its mouth to about two and one-half miles up.

14. Oldman river, from Southfork river to its head, about twenty-five miles.

15. Livingstone river and tributaries, about eighteen miles.

Total mileage explored on rivers and creeks, three hundred and sixty-nine miles.

The above explorations, not including Oldman river, Livingstone creek and tributaries, were finished on September 1. I then proceeded with hydro-topographic surveys of the locations which I thought would be of some value for water-power, as follows:—

1. St. Mary river, from the intake of the Alberta irrigation canal, about three and one-half miles to the head of the canyon in sections 25 and 23, township 1, range 25, west of the fourth meridian.

2. St. Mary river, from the northwest quarter of section 24 to the southwest quarter of section 10, township 6, range 23, west of the fourth meridian.

3. Lee creek, from the southeast quarter of section 35, township 2, range 26, west of the fourth meridian, to Cardston.

4. Tib creek (or north fork of Belly river), from its mouth to the forks, situated in the Blood Indian reserve timber limit.

5. Waterton lake, the narrows.

6. Oil creek, from its mouth (Waterton lake) to about one mile up.

7. Blackiston brook, from Waterton lake to about four miles up through section 6, township 2, range 29, and sections 1, 2, 3, 4 and 5, township 2, range 30, west of the fourth meridian.

8. Southfork river, from the southeast quarter of section 24 and the northeast quarter of section 13, township 6, range 2, west of the fifth meridian.

9. Crowsnest river, in the northeast quarter of section 21, township 7, range 2, west of the fifth meridian.

In the working of these surveys and explorations it was necessary to haul the outfit about nine hundred miles; only in a few places was difficulty experienced in getting through.

On November 2, having accomplished most of the work contemplated and the weather being very severe, I stopped field operations.

On November 20, I resumed field work and explored Oldman and Livingstone rivers and their tributaries. I also secured some more information from the Commissioner of Irrigation at Calgary, as to gauge readings, etc., observed during the past summer.

The flood last summer was unusually high, the season of low water was longer, and the water was lower than usual. The earlier part of the season was hot and dry, and during the remainder the weather was variable. In the middle of September there was a snowfall of one foot, and from that time until my field operations ceased there were few days of fine weather.

The instruments used in the hydro-topographical survey were a four-inch Watt's theodolite, Surveyor General's model, a strong, compact, light, accurate and handy instrument; an eighteen-inch Stanley dumpy level, well finished, having a powerful telescope, and of great precision; a stadia rod; a Keuffel and Esser stadia sliding rule; a four-chain steel tape; a four-inch Watt's aneroid; an Abney hand level, and a prismatic compass. The last three named instruments were principally used for reconnaissance. The Stanley dumpy level was used principally to ascertain the difference of elevation between the proposed mill site and intake.

Distances and elevations in general in the topographical work and of traverses were measured with the theodolite and stadia rod and reduced with the slide rule.

Where the theodolite was used instead of the level to find the elevation from one station to another, I have used the following table of allowance to be added for curvature of the earth and refraction combined:

Distance in feet.	Allowance in feet.
600 ft.	·007
900 ft.	·017
1,200 ft.	·030
1,500 ft.	·046
1,800 ft.	·066
2,100 ft.	·090
2,400 ft.	·116

All the surveys of water-powers were connected with some section monuments (with one exception). I may state, in many places through the ranching country in southern Alberta, posts are missing. It is customary for cowboys and others to pull up the survey posts and use them to stake their horses.

With the exception of Tib creek all the levelling was connected with some bench marks of the Canadian irrigation survey or the Canadian Pacific railway.

GAUGING THE VELOCITIES OF STREAMS BY MEANS OF A CURRENT METER.

My first operation in making a careful gauging of the velocity by means of a current meter was to choose a good station. The aim has been to find some point on the course of a stream where its bed and banks are nearly permanent, the current of moderate velocity, and the cross-section area uniform for about two hundred feet above and below the gauging station. At this point a standard steel tape was stretched across the stream at right angles with the general direction of the current and a tag mark placed every ten feet. To ascertain the depth a gauging rod was made with a pole on which was tacked a flexible rod divided in feet and tenths. All the measurements were made by wading.

Current Meter.

The current meter used was Gurley's new model No. 617. It has several new features in the way of improvements. This meter was tested by the Assistant Hydrographer of the United States Geological survey and was found very satisfactory. He has furnished a rating table for S. P. Patents, new model, the new meter rating satisfactorily with it. In this meter a contact device has been arranged so that each fifth revolution instead of each single revolution of the wheel is indicated. The meter is equipped with a cable and a wet cell telephone attachment.

In using the meter, the time taken for a certain number of revolutions is observed instead of the number of revolutions for a given time. This increases the accuracy of the work and also the ease with which the observation may be taken. In taking the time a stop watch was used.

The meter rating table has been made to give the velocity corresponding to the number of seconds which it takes to make a given number of revolutions. As the streams measured were shallow, the mean velocity in a vertical line was determined by holding the meter at six-tenths depth, instead of holding the meter at two-tenths and eight-tenths depth, which is the usual method. The mean of the two results is considered more accurate than a single reading at six-tenths depth.

Two or three measurements made at the same place, the local conditions being the same, has shown a maximum variation of one and one-half per cent.

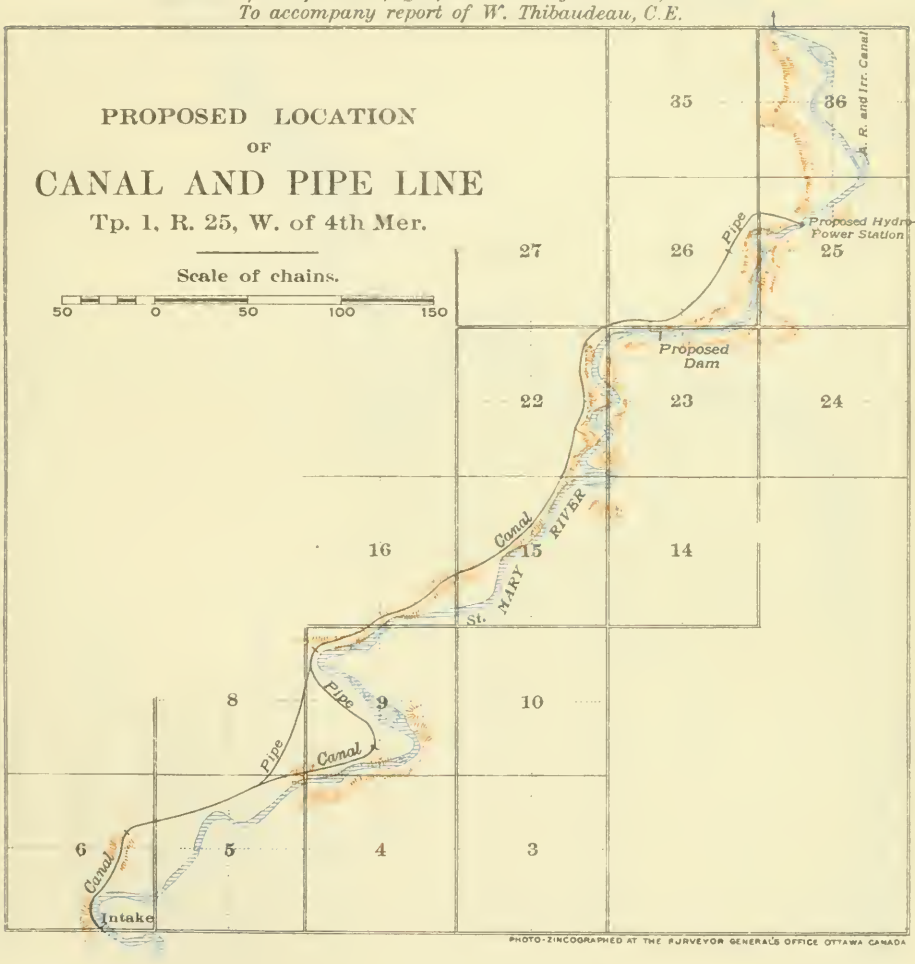
The following summary shows upon what I have based my estimate of cost of plants on the locations selected by me as suitable ones for generating power and of which I have made a hydro-topographical survey. The summary for each location will contain the drainage area, the average rainfall and run off, the character of the drainage area, &c., and any other data at my disposal secured from the Canadian Irrigation Survey branch.

There were three places, one in section 24, one in section 25, township 6, range 23, west of the fourth meridian on the St. Mary river where water-power could be developed by means of a tunnel; also one on Belly river. Although no external surveys were made, from the data I have I believe about five hundred feet of tunnel on the two former would develop 780 horse-power and 650 horse-power respectively. The one on Belly river would give 1,200 horse-power on section 33, township 8, range 24. Unfortunately I discovered the feasibility of these powers only on my return and they have not been thoroughly investigated. These mill sites would be handy to Lethbridge.

UPPER ST. MARY RIVER.

Estimate of cost of hydro-electric plant for 10,200 horse-power proposed to be erected in the northwest quarter of section 23, township 1, range 25, west of the fourth meridian.

Annual report of the Topographical Surveys Branch, 1908-1909.
To accompany report of W. Thibaudeau, C.E.



PROPOSED LOCATION OF CANAL AND PIPE LINES AND PROPOSED DAM

Tp. 1, R. 25, W. of 4th Mer.

Scale of chains.

10 0 10 20 30 40 50

NOTE:—Traverse lines are shown in red
Contour elevations are in feet.

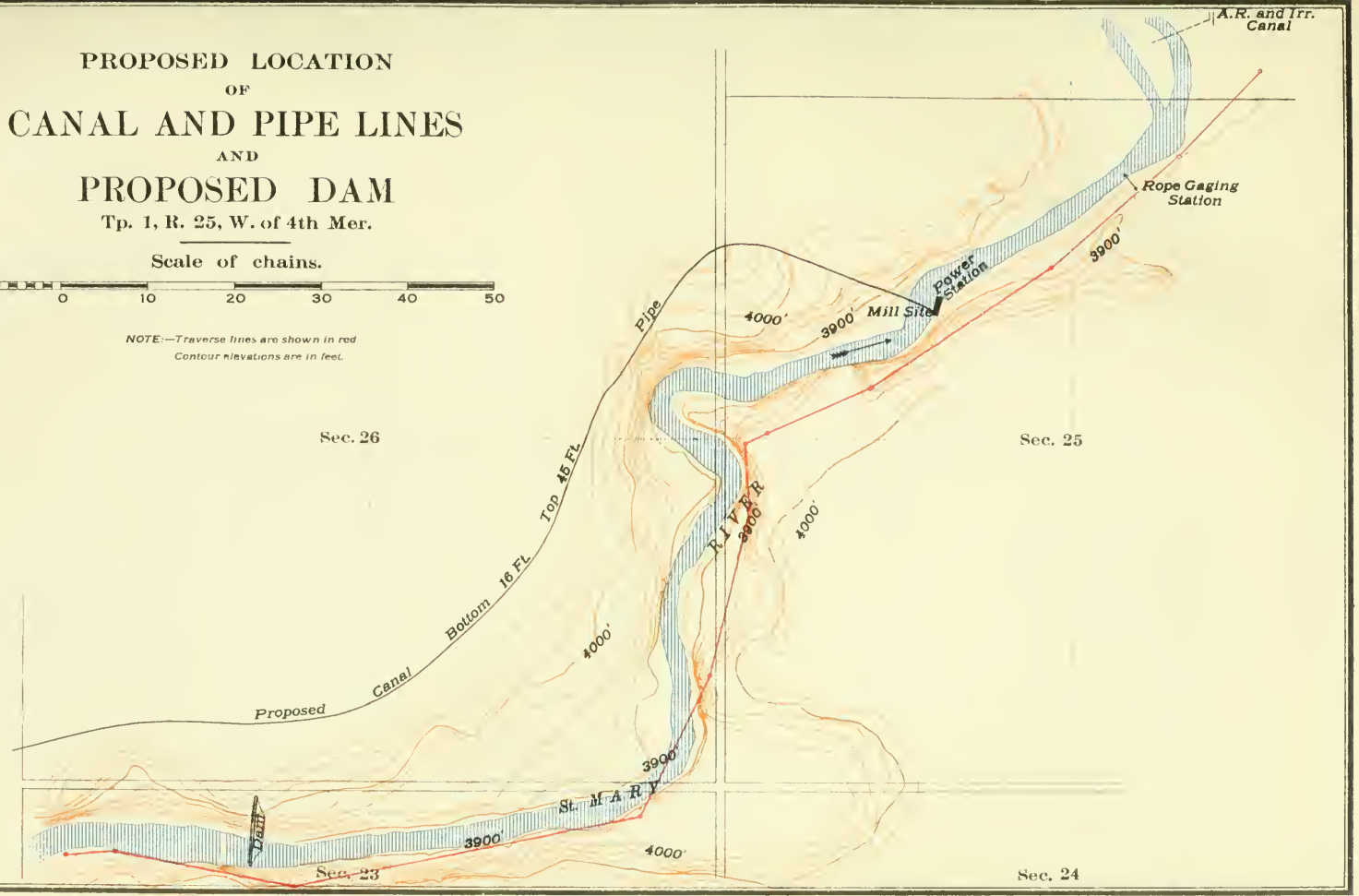


PHOTO-ZINCOGRAPHED AT THE SURVEYOR GENERALS OFFICE OTTAWA, CANADA

Topographical Description.

The upper St. Mary river valley which is well defined, consisting of rolling slopes, (open prairie with no timber) and some cut banks, is half a mile wide; the river cuts through it at an average depth of one hundred and forty feet. The water is clear, cold and free from silt. From the southeast quarter of section 23 to the northwest corner of section 25, the valley takes the form of a canyon which averages one hundred and fifty feet in depth. The bottom is of solid sandstone and limestone, visible nearly everywhere. The banks consist of alternate layers of sandstone, limestone and hard clay. The upper part of the river valley to the international boundary consists alternately of flats and cut banks fifty to one hundred feet in depth.

The strike is northeast and southwest, the dip is about five and a half degrees southerly.

The drainage conditions are favourable for a quick run off.

The river carries no drift wood and the most favourable location for a dam is in northwest quarter of section 25, township 1, range 25. The surrounding country is well adapted for wheat raising; last season the crop was good and did not require irrigation. In a few places there are croppings of good coal.

Survey.

The survey of the water-power was connected with the quarter section monument on the east boundary of section 6, township 1, range 25.

Levels were connected with the Canadian Irrigation survey sill of intake of the Alberta Railway and Irrigation company's canal, elevation 3,854 feet.

The lands to be reserved for mill sites are the northwest quarter of section 25 and the south half of the southeast quarter of section 26 and the west half of the northwest quarter of section 23, township 1, range 25.

Drainage Basin.

The drainage basin of St. Mary river south of the boundary line is three hundred and ninety-five square miles, bounded to the south by the continental divide. At the proposed dam and mill site locations the drainage area is four hundred and fifty square miles.

Maximum and Minimum Flow of Water.

From the available records at my disposal I found that the seasons of minimum flow (about five hundred and twenty foot seconds) appear to be between April 10 to 16 and September 1 to 20.

Last year high water at flood level was reached between June 1 and 14, and it is estimated that on June 5 the flow was 16,000 foot seconds, which was the highest in years, the gauging station at Kimball recording 11 feet.

Gauging.

CANADIAN IRRIGATION SURVEY.

September 1, 1906 near Kimball	5,081	foot seconds.
August 3, 1907	2,026	" "
June 29, 1908	2,836	" "
September 1, 1908	519	" "
September 16, 1908	519.8	" "

Note by the Surveyor General.—Mr. Thibaudeau was directed by his instructions to investigate water-powers. In order to make the investigation more complete he has in every case furnished estimates for the establishment of a hydro-electric plant. The cost of developing the water-power alone can be found by leaving out of the estimate the items relating to the electric plant.

Location of Dam.

The proposed dam is situated about twenty miles from Cardston station; the roads in that locality are fair. Freight rates from Cardston to the mill-site would be about $4 per ton.

Estimated Cost of a Masonry Dam.

Height of dam, 140 feet.
Length of dam, bottom, 250 feet.
Length of dam, top, 570 feet.

Assuming that the ground would have to be excavated to a depth of ten feet at the side and bottom, the cubic contents would be 150,000 cubic yards; estimating this at $6 per cubic yard, the cost would be $900,000.

Cost of dam	$ 900,000
Cost of wheel plant	612,000
Cost of electric plant	255,000
Total cost of plant	$1,767,000
Cost per horse-power in bringing water to turbine	$ 88 23
Cost of wheel plant per horse-power	60 00
Cost of electric plant per horse-power	25 00
Total cost per horse-power in developing plant	$173 23
Placing depreciation on whole plant at	2 per cent.
Repairs	1 "
Interest	6 "
Taxes and insurance	1 "
Total	10 "

Cost of Operation.

Fixed expenses per horse-power, $173.23 at 10 per cent.	$17 32
Running expenses per horse-power	2 00
Total cost per horse-power per annum (24 hour day)	$19 32

Further investigation has shown that a more economical way of developing power would be to carry the water from the international boundary by means of canal and pipes to a point in the northwest quarter of section 25, township 1, range 25, west of the fourth meridian above the intake of the Alberta Irrigation canal and the cable gauging station.

The elevation at the international boundary line is 4,136 feet; at the point where I propose to erect a power plant the elevation is 3,862, a difference in elevation of 274 feet. The distance by the river is nine and three-quarter miles, which gives an average fall of about twenty-eight feet per mile. It would require about seven miles of canal, bottom sixteen feet, slopes 2-1, area 188 square feet, depth of water 6·5 feet, height of bank 10 feet, grade per mile 1·6 feet, velocity 3·0 feet per second, volume of water 564 foot seconds. This canal would require the excavation of 36,700 cubic yards per mile; at 50 cents per cubic yard the cost would be $18,350. Total cost for 7 miles, $128,450.

The Canadian Pacific railway, in their irrigation scheme for earth excavation, pay from fifteen to sixteen cents per cubic yard; for loose rock, thirty to thirty-five

PROPOSED INTAKE
ON
ST. MARY RIVER
AT THE
INTERNATIONAL BOUNDARY

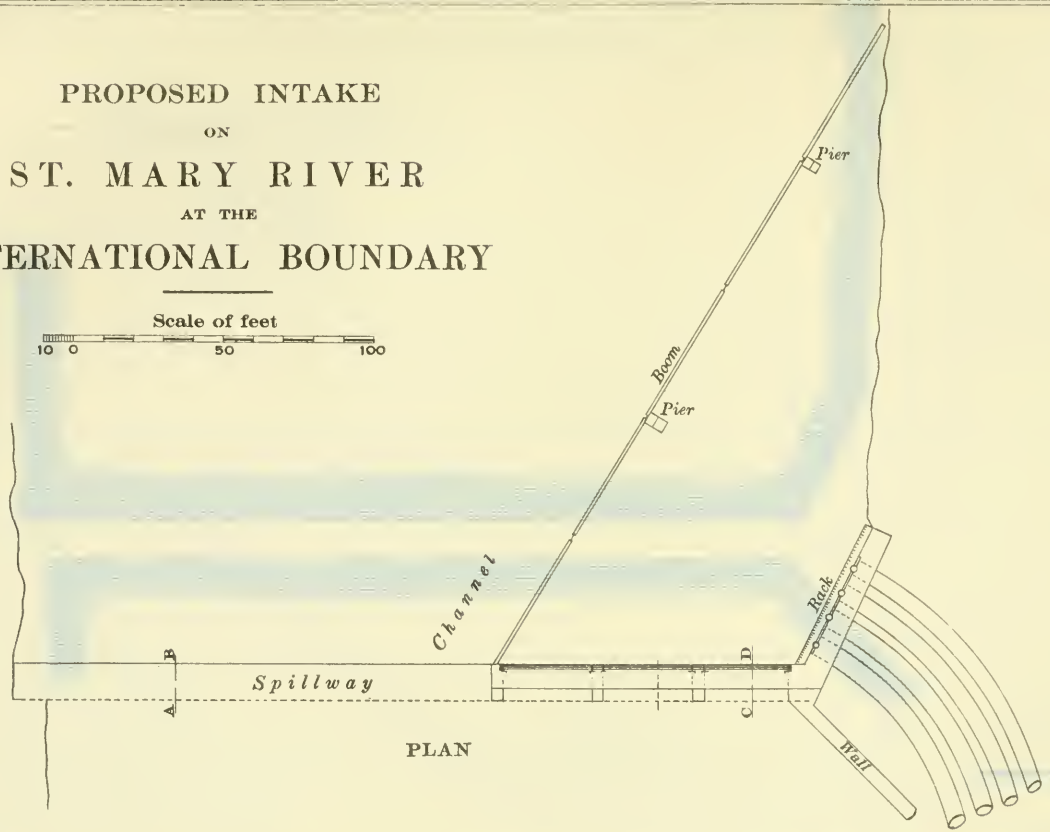
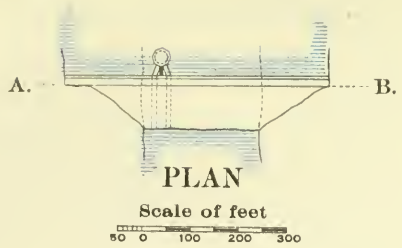


PHOTO-ZINCOGRAPHED AT THE SURVEYOR GENERAL'S OFFICE OTTAWA, CANADA



PRACTICAL DIAGRAM

FOR

PROPOSED MASONRY DAM

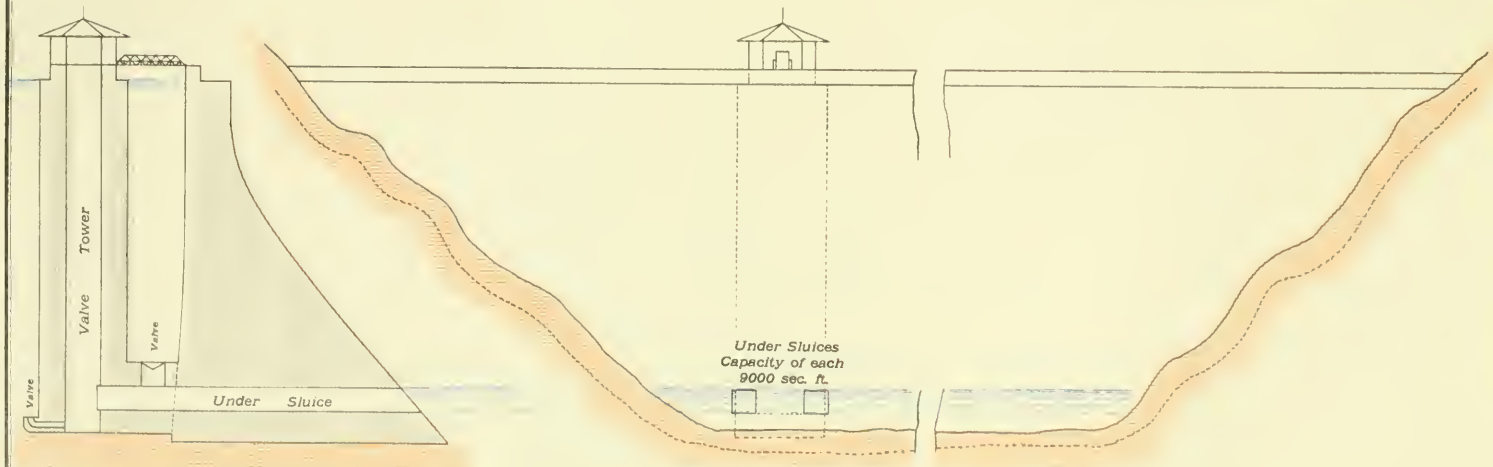
ON

ST. MARY RIVER

Tp. 1, R, 25, W. of 4th Mer.

Scale of feet

10 0 50 100



Section of Dam through centre of Valve Tower

Cross Section of River at AB.

PHOTO ZINCOGRAPHED AT THE SURVEYOR GENERAL'S OFFICE OTTAWA, CANADA

cents per cubic yard, and for solid rock, one dollar per cubic yard. The fifty cents per cubic yard makes allowance for loose rock and solid rock which may occur in the excavation, although not apparent.

Construction material (except stone and lime) would have to be hauled from Cardston.

Pipe.

I propose to carry the water from the canal by four stave pipes six feet in diameter, factor of safety 4, grade nine feet per mile, giving a velocity of five feet per second or a flow of 565 foot seconds.

At no point will the pressure on the pipes be more than fifty feet head, except near the power house where steel pipe will have to be used.

Estimate of Cost of Canal and Pipes.

Timber	$2 26	per lineal foot.
Iron	3 00	"
	$5 26	"
Preparing ground	0 30	"
Cost per mile	$ 29,356 80	for 1 pipe.
" "	117,427 20	" 4 "
Three miles of four pipes	352,281 60	
Total cost of canal and pipes	$480,731 60	

I am confident that in the final location of the pipe line the distance will be shortened enough to cover the increased cost of steel pipe.

Estimated Horse-power.

From two hundred and seventy-four feet difference of elevation between the international boundary and the proposed mill site, deducting the grade for seven miles of canal and three miles of pipe (thirty-six feet) there remains an effective head of two hundred and thirty-eight feet with an average of 565 foot seconds giving 14,933 horse-power.

Estimated Cost of Plant.

Intake.

Masonry, 850 cubic yards at $6	$5,100	
Timber, 26,000 feet B.M. at $33	858	
		$ 5,958
Canal and pipes		480,731
Wheel plant		895,960
Electrical equipment		373,325
Total cost		$1,755,974
Cost per horse-power in bringing water to turbine		$ 32 60
" " wheel plant		60 00
" " electrical equipment		25 00
Total cost per horse-power		$117 60

Cost of Operation.

	Per cent.
Placing depreciation on whole plant at	2
Repairs	1
Interest	6
Taxes and insurance	1
Total	10

Fixed expenses per H.P. $117.60, at 10 per cent.	$11 76
Running expenses	2 00
Total cost per H.P. per annum (of 24-hr. day)	$13 76

Comparison of Cost.

First Development Plant.—Cost per horse-power, including dam, wheel plant and electrical equipment, $173.23.

Second Development Plant.—Cost per horse-power, including intake canal, pipe line, wheel plant and electrical equipment, $117.60.

Another advantage of the second plant is that it might be started by building only one stave pipe and canal, others being added as the demand required, thus making the initial cost for one pipe about $538,846, giving 3,744 horse-power.

The main transmission line should go direct from the power house to Lethbridge, a distance of forty-five miles, then to Macleod, sixty-nine miles. Small progressive towns such as Cardston, Magrath, Sterling and Raymond (the latter has a large sugar beet factory, where a large amount of power would be utilized), could be supplied from the main transmission line.

These towns would be the principal fields of operation for a company which would build on the upper St. Mary river, as at present the only available source of power is steam.

This location for a large hydro-electric plant is one of the best and cheapest to be found on the eastern slope of the Rocky mountains, south of Calgary.

LOWER ST. MARY RIVER.

In the southwest quarter of section 24, township 6, range 23, west of the fourth meridian, I found a good location for a dam about ninety feet in height, situated about sixteen miles southerly from Lethbridge.

On the eastern side of the river there is an almost perpendicular wall of solid sandstone formation. The river bottom is of solid rock formation visible nearly everywhere. On the western side the bank slopes at an angle of about 40°; the formation is sandstone partly covered with a thin layer of gravel and loam; the bedding of the country rock lies horizontal. The conditions looked so favourable for the development of water-power that I made a topographical survey of the site. The flow of water was found on gauging to be about three hundred foot seconds.

Under ordinary conditions during the irrigation season, no greater quantity of water could be depended upon as the Alberta Irrigation company have secured the right to use 500 foot seconds for irrigation purposes, and there is no tributary of any importance from the intake of the above company to this point; Lee creek, the most important, discharges between eleven and sixteen foot seconds in ordinary seasons.

The drainage area of the river at this point is 1,010 square miles, the greater part of which consists of open, sloping and rolling country; the soil is a rich loam producing fine crops of wheat and other grain; there are also some croppings of good coal in the vicinity.

I noticed in some parts of the canyon that the high water mark at flood level had reached a height of twenty-five feet above the ordinary level. At those points a cross-section of the river would give about 4,500 square feet. At the time, this did not cause me much worry on account of the reports of the Canadian irrigation surveys giving the flow of high water at flood level to be about 7,000 or 8,000 foot seconds. On my return to Ottawa, I obtained from the Commissioner of Irrigation at Calgary gauge readings of high water at flood level, taken at Kimball during the past season, also some gauging from which I have deduced the probable flow of the river at high water to be in excess of 30,000 foot seconds. It must be remembered that the drainage area at this point is more than double of what it is on the upper St. Mary river, where it was found that the flow of water at flood level exceeded 16,000 foot seconds; the conditions at this point are most favourable for a quick run off after a heavy rain.

With a dam ninety feet high under ordinary conditions an average of 2,060 H. P. could be depended upon; but I believe it would not be practical on account of the possibility of a flood like last season, when it would have required a weir eight hundred feet long with a depth of six feet of water over the crest. The cost would be about $650.00 per H. P. which would be prohibitive.

ST. MARY RIVER.

Gauging made September 20, 1908.

Gurley Meter No. 617.

Discharge 305 foot seconds.

Sounding.		Depth of Observation.	Revolution.	Second.	—
Distance from zero point.	Depth.				
1	.....	6/10	.....	.....	
3	0·73	.....	.....	.....	
10	1·92	.....	5	33·4	
20	1·82	.....	20	57·6	
30	1·85	.....	20	30·0	
40	2·40	.....	35	45·4	Mean velocity ·758 feet per second.
50	2·64	.....	30	38·8	
60	3·18	.....	40	52·6	
70	2·75	.....	30	37·8	Gauged in southwest quarter of section 24, township 6, range 22, west of the fourth meridian.
80	3·64	.....	20	46·2	
90	2·40	.....	20	66·4	
100	0·64	.....	5	40·8	
104	0·00	.....	0	.....	

LEE CREEK.

Estimate of cost of a small hydro-electric plant for 172 horse-power proposed to be erected at Cardston, Alberta.

Topographical Description.

1. Lee creek a tributary of St. Mary river, at certain seasons is a regular torrent; it receives its supply principally from the precipitation of the northern slope of Chief

mountain. Its general direction is northeast and southwest. The area of its drainage basin is 133 square miles, one-third of which is south of the international boundary.

From Cardston to the proposed intake location in the southeast quarter of section 35, township 2, range 26, west of the fourth meridian, at the foot of what they call 'the canyon,' the creek winds its tortuous course through a narrow valley, averaging half a mile in width, which is surrounded by steep hills. There are sandstone cut banks in places; the balance consists of gravel or loam, which is under cultivation, the country rock lies horizontal.

At the end of July, when I explored the creek, the water was clear and cold, with a flow of twenty foot seconds. The drainage basin, being open and rolling, is favourable to a quick run off.

Last summer at high water the flood stage was very large, carrying away houses in many places and one bridge. The minimum flow is about twelve foot seconds, and occurs in April and September.

The creek elevation at the power house (B.M. power house floor 3,666 feet) is 3,686 feet, and at the intake it is 3,855, a difference in elevation of 169 feet.

The water from the intake to Cardston would be carried in a stave pipe, twenty-seven inches diameter, four miles long, grade 10·5 feet per mile, velocity four feet per second, flow sixteen foot seconds. Deducting grade of pipe (forty-two feet), there remains an effective head at Cardston of one hundred and twenty-seven feet.

If the water is to be used for waterworks, this would give a pressure of fifty-five pounds per square inch, and would supply a population of 2,500 people; at present steam is the only source of power.

The minimum flow (twelve foot seconds), with one hundred and twenty-seven feet head, will generate 172 horse-power. The minimum flow was deduced from gauging made by the Canadian irrigation surveys extending over a period of years.

Survey.

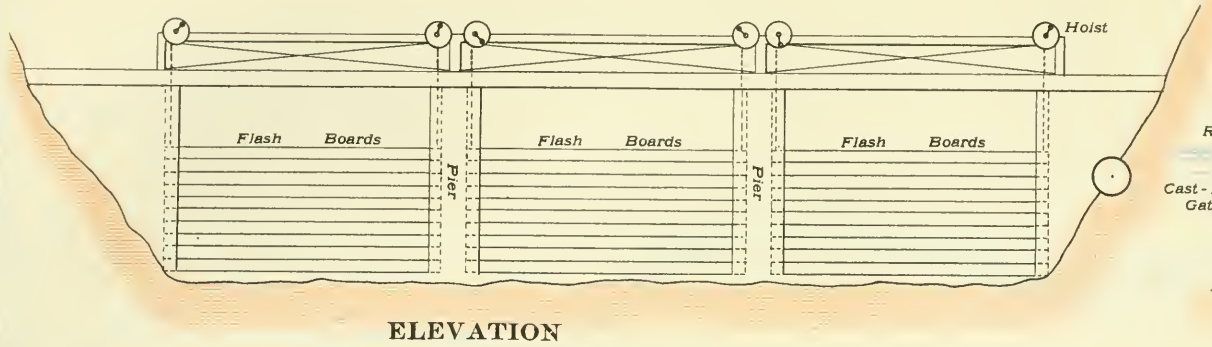
The survey of the dam site was connected with the southeast corner of section 26, township 2, range 26.

The levels were connected with the Canadian irrigation survey, bench mark '49,' elevation 3,793 feet.

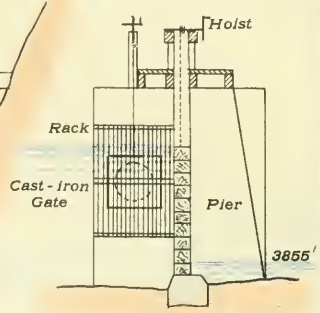
The lands to be reserved for a dam site are the southwest quarter of the southwest quarter of section 36 and the southeast quarter of the southeast quarter of section 35, township 2, range 26.

Estimated Cost of Plant.

Intake—		
Masonry, 120 cubic yards at $6		$ 720 00
Timber, 14,000 feet B.M. at $35		490 00
Total		$1,210 00
Four miles pipe at $1.90 per lineal foot, or $10,032 per mile	$ 40,128 00	
Excavation to cover pipe, 7,000 cubic yards at 50c.	3,500 00	
Wheel equipment	8,600 00	
Electrical equipment	5,160 00	
Total cost		$58,598 00
Cost per horse-power in bringing water to turbine		$260 68
Cost per horse-power, wheel plant		50 00
Cost per horse-power, electrical equipment		30 00
Total cost per horse-power		340 68



ELEVATION



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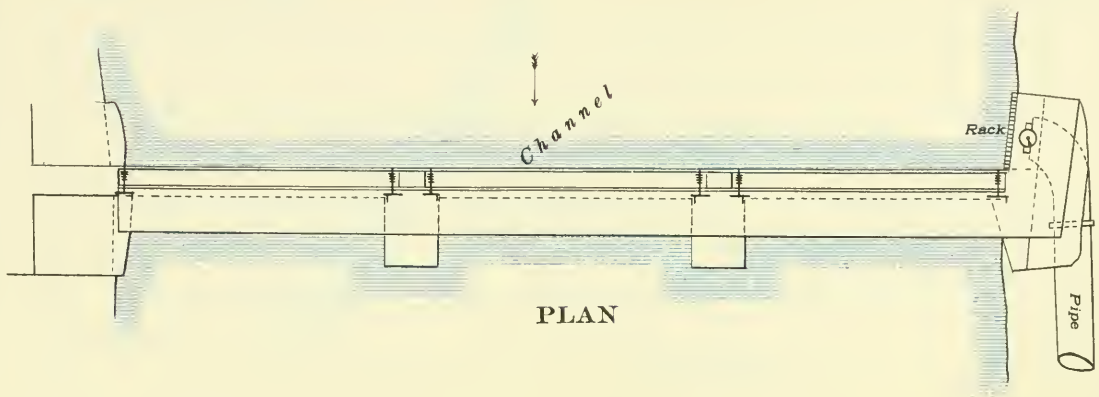


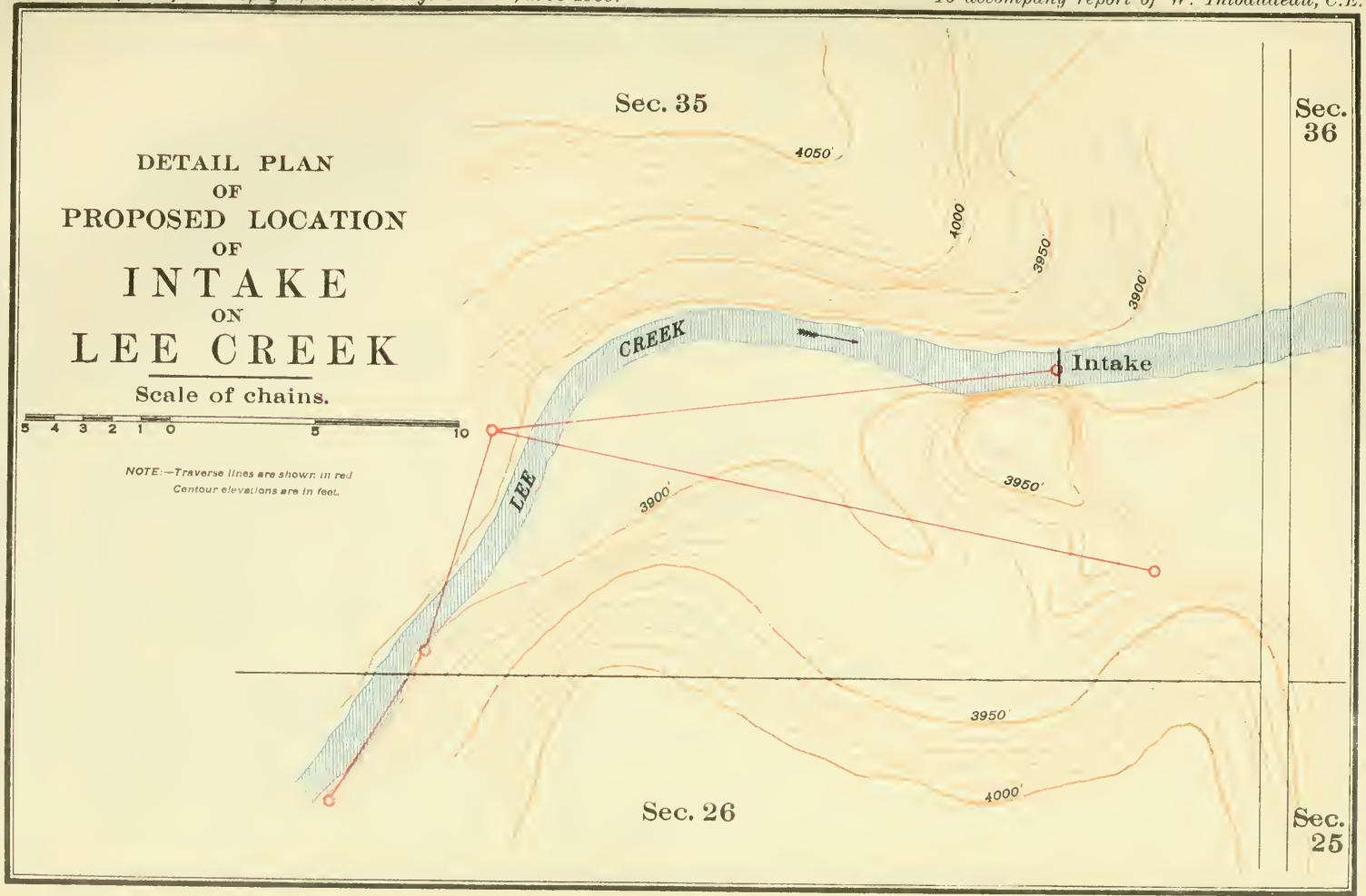
PLAN

INTAKE
LEE CREEK

Scale of feet.

5 0 5 10 15 20

PHOTO-ZINCOGRAPHED AT THE SURVEYOR GENERAL'S OFFICE OTTAWA CANADA



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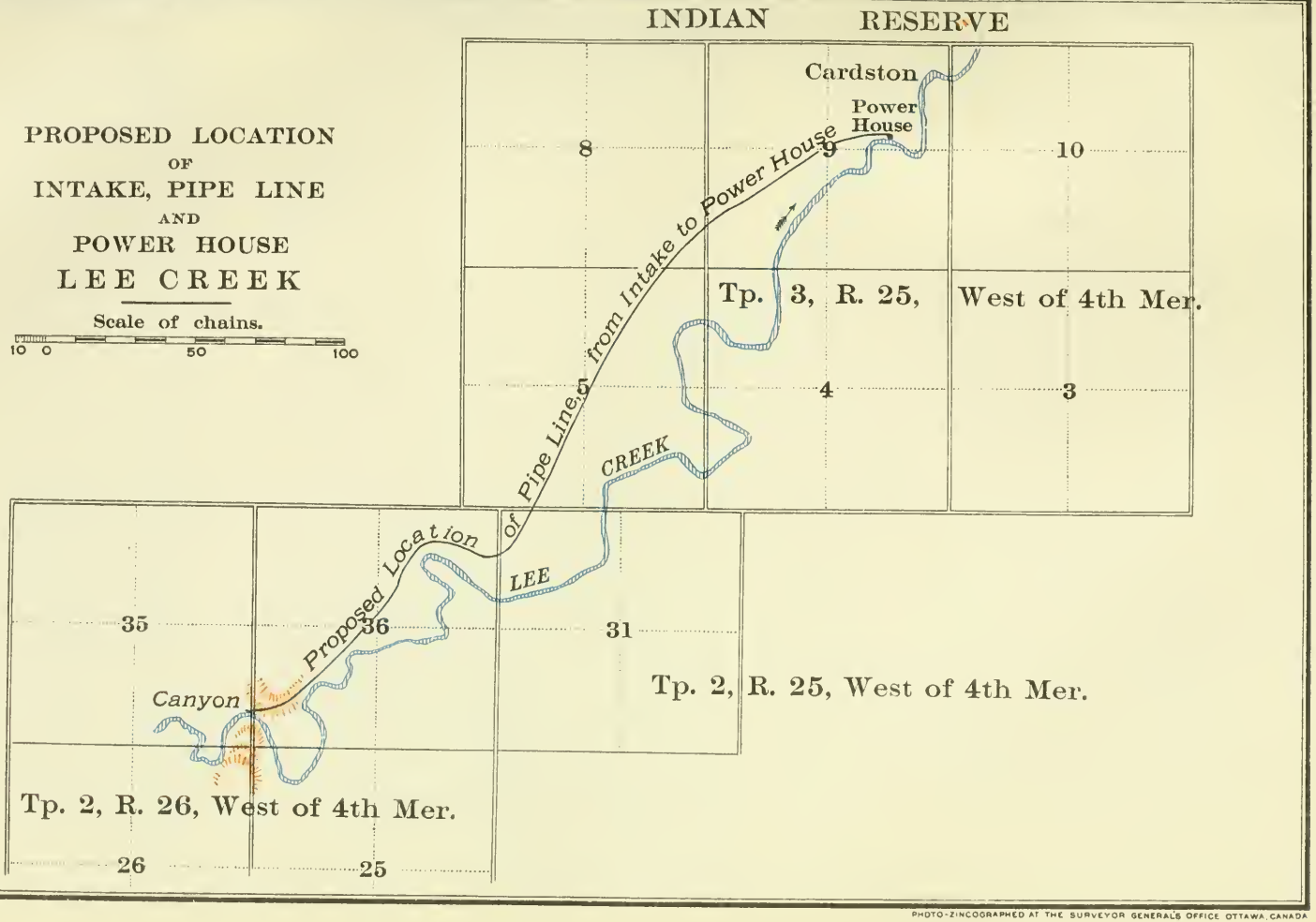


PHOTO-ZINCOGRAPHED AT THE SURVEYOR GENERAL'S OFFICE OTTAWA, CANADA

Cost of operation

	Per cent.
Placing depreciation of whole plant at	2
Repairs	1
Interest	6
Taxes and insurance	1
Total	10
Fixed expenses per H.P., $34.068 at 10 per cent	$3 41
Running expenses	2 00
Total cost per H.P. per annum (for 24-hr. day)	$36 01

TIB CREEK.

Estimated cost of a hydro-electric power plant for 1,364 horse-power proposed to be erected on Tib creek in the Blood Indian timber reserve.

Topographical Description.

Tib creek is a tributary of Belly river, which it joins about two and one-half miles north of the international boundary. It receives its water supply from the snow melting on the surrounding peaks; its valley is narrow, varying from one-third to one-half mile in width; it runs in a southwesterly direction, rising south of the international boundary. The right limit of the creek follows the foothill closely, while the left side consists of benches, covered with timber in the valley. The country rock is overlaid with gravel and loam.

Some places along the creek are canyon like, consisting partly of sliding material. On the left limit there are a couple of canyons cutting through the benches. Pipes would have to be carried across the canyons by means of trusses about sixty feet in length. From the foothills the valley and sidehills are partly timbered with spruce and pine of some commercial value. About half a mile down stream from the proposed intake there is a rock cropping of sulphate of lime (gypsum), which I believe might prove of some commercial value as plaster of paris. The creek at flood level is a regular torrent and carries some driftwood. As the benches are very irregular and swampy in places the water from the intake to the wheel plant would have to be carried through pipes. The water is clear and cold. On account of its high altitude the country in this vicinity is better adapted for grazing than farming.

Survey.

The survey was connected with the international boundary at its intersection with Belly river on the right bank. The levels were connected at the same place, the elevation at that point deduced from interpolation from data on both sides of the international boundary.

The lands to be reserved for mill site contain one hundred and sixty acres, the west boundary being ten chains west of the location of the mill site, the north and south boundaries twenty chains each from the same point.

Drainage Basin.

The drainage basin of the creek is about forty square miles, twenty-five square miles of which is south of the international boundary.

Minimum Flow.

August 22, 1908, I estimated the flow to be about forty-five foot seconds.

October 23, 1908, gauging gave flow at fifty foot seconds. On account of the country being timbered in the valley and containing many snow peaks I consider the minimum flow to be about thirty-five foot seconds; no data being available, comparing the drainage basin of this creek with Waterton river, which is similar, my estimate would be on the safe side.

Location of Power Plant.

The proposed power plant is situated in the Blood Indian timber reserve at the foothill about seventeen miles from Cardston; the roads are fair.

Freight rate from Cardston would be about $6 per ton.

Estimate of Cost of Pipe Line.

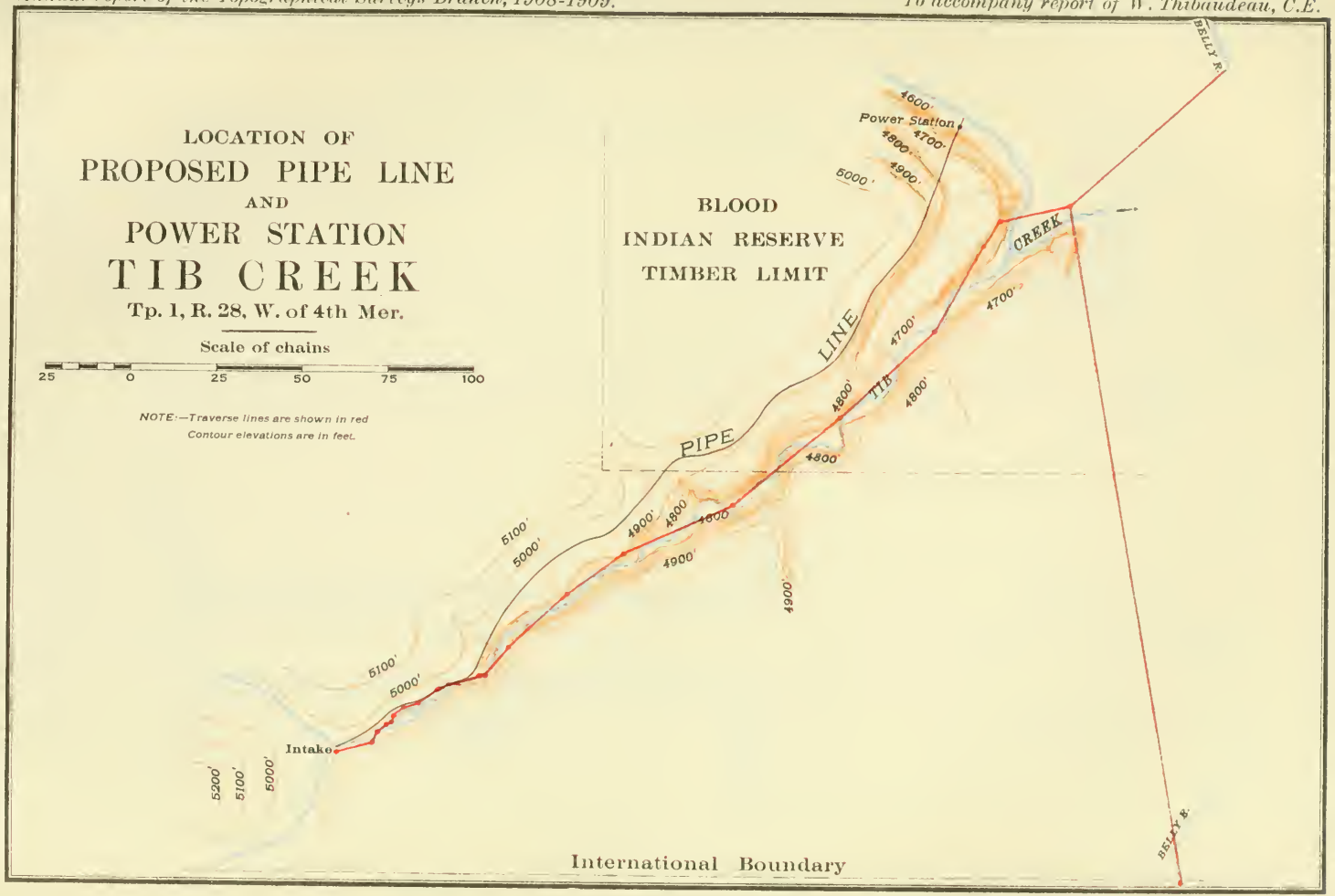
It would require four miles of stave pipe thirty-six inches in diameter, grade sixteen feet per mile, velocity six feet per second, flow forty-two foot seconds, price $2.30 per foot, or $12,144 per mile. For four miles, $48,576.

Estimated Horse-power.

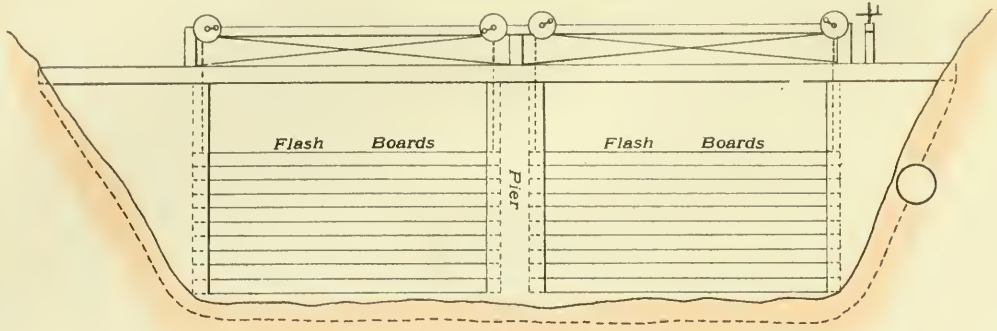
Elevation at proposed wheel plant is 4,552, elevation at point of intake, which is situated at the forks is 4,965, making a difference in elevation of 413 feet; deducting grade of four miles of pipe (64 ft.) there remains an effective head of 349 feet which gives 1,364 horse-power.

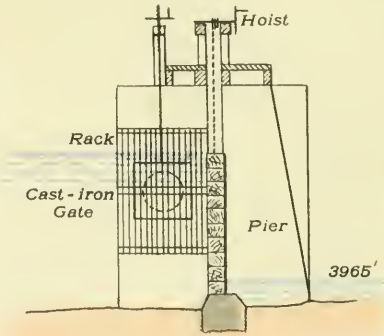
Estimated Cost of Plant.

Intake—		
Masonry, 90 cubic yards at $6	$540 00	
Timber, 10,000 feet B.M. at $35	350 00	
Total		$ 890 00
Pipes		48,576 00
Excavation for pipes, 7,000 cubic yards at 50c		3,500 00
Wheel plant		68,200 00
Electrical equipment		40,920 00
Total cost		$162,086 00
Cost per horse-power in bringing water to turbine		$ 38 33
Cost per horse-power wheel plant		50 00
Cost per horse-power electrical equipment		30 00
Total cost per horse-power		$ 118 33
Placing depreciation on the whole plant	2%	
Repairs	1%	
Interest	6%	
Taxes and insurance	1%	
Total	10%	

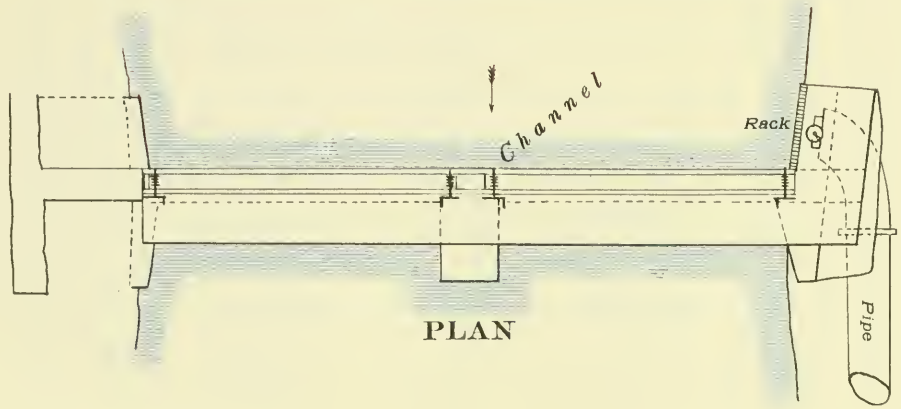

LOCATION OF
PROPOSED PIPE LINE
AND
POWER STATION
TIB CREEK
Tp. 1, R. 28, W. of 4th Mer.
Scale of chains
25 0 25 50 75 100
NOTE:—Traverse lines are shown in red
Contour elevations are in feet.
BLOOD
INDIAN RESERVE
TIMBER LIMIT
PIPE LINE
TIB CREEK
Power Station
Intake
BELLY R.
BELLY R.
1600'
4700'
4800'
4900'
5000'
5100'
5200'
4800'
4700'
4900'
International Boundary
PHOTO-ZINCOGRAPHED AT THE SURVEYOR GENERAL'S OFFICE OTTAWA, CANADA

ELEVATION





SECTION



PLAN

INTAKE
TIB CREEK

Scale of feet.

5 0 5 10 15 20

PHOTO-ZINCOGRAPHED AT THE SURVEYOR GENERAL'S OFFICE OTTAWA, CANADA

Fixed expenses per horse-power per annum, $188.83 at 10%	$11 88
Running expenses	2 00
Total cost per horse-power per annum (for 24 hr. day)	$13 88

The power generated by this plant could be transmitted to Cardston, a distance of seventeen miles, or to Macleod, forty-five miles, where it could be used for manufacturing purposes.

Gauging made October 2, 1908.

Gurley meter No. 617.

Discharge 51 foot seconds.

Sounding.		Depth of Observation.	Revolution.	Second.	Velocity.	—
Distance from zero point.	Depth.					
5	1·10	$\frac{6}{10}$	20	40	1·17	
10	1·80	.....	20	21	2·20	
15	2·10	.....	20	22	2·10	
20	1·60	.....	10	30·5	1·00	
25	0·00	.....	.....	.....	.....	Blood Timber Reserve.

NOTE—On October 4 discharge 49·8 foot seconds. October 5 discharge 50·8 foot seconds.

WATERTON LAKE.

Estimate of cost of a hydro-electric plant for 1,127 horse-power proposed to be erected at the head of the narrows of the upper Waterton lake in the northeast quarter of section 23 and northwest quarter of section 24, township 1, range 30, west of the fourth meridian.

Topographical Description.

The upper part of the lake above the narrows covers an area of 4·3 square miles, 2·4 square miles on the Canadian side, 1·9 square miles on the American side, and runs in a southerly direction, while the lower part runs in an easterly direction; the mountains are free from timber, but some may be found on the gulches and on the flats; at the head of the lake there is about two square miles of marketable timber. The lake is very picturesque and attracts many visitors every summer.

The narrows are 375 feet wide and the banks and bottom are of hard crystallized limestone. On both sides of the lake above ,and on the east side below the narrows, the mountains rise directly from the edge of the lake, while on the west side below the narrows there is a valley varying in width from half a mile to one and one-half miles, free from timber except for a narrow strip of cottonwood on the flats. The valley below the narrows is well adapted for grazing, but on account of its high altitude is of little value for raising grain.

Survey.

The survey was connected with the southeast corner of section 35, township 1, range 30. It was found in plotting that some mistake had been made in reading

the distance or angle of some course, or in entering the reading in the note-book which was done by my assistant. The section lines are shown only approximately, but the mill sites are well within the area reserved for that purpose.

The levels were connected with the Canadian irrigation survey, Waterton lake, elevation 4,186 feet.

The lands to be reserved for mill site are the southeast quarter of section 26, the northeast quarter of section 23 and the west half of the southeast quarter of section 23, township 1, range 30.

Drainage Basin.

The drainage basin of the upper Waterton lake is about 230 square miles, of which about 110 square miles is south of the international boundary, and is bounded on the west by the continental divide.

Maximum and Minimum Flow.

From the available records at my disposal I would estimate the minimum flow at 200 foot seconds occurring between April 1 and 15 and September 5 and 20. The high water mark at flood level is about ten feet above the ordinary level.

Gauging.

September 10, 1906	442 foot seconds	Canadian Irrigation Surveys.
September 20, 1907	2,176 " "	
September 5, 1908	205 " "	W. Thibaudeau.
September 18, 1908	238 " "	
October 16, 1908	503 " "	

Location of Dam.

The proposed dam is situated twenty-eight miles from Cardston and thirty-five miles from Pincher, the two nearest railway stations; the roads to both places are fair. There is also a saw-mill in the vicinity. Freight rate from Cardston to the mill site would be about nine dollars and about twelve dollars from Pincher.

Estimated Cost of Masonry Dam.

Height of dam	50 feet.
Length of dam bottom	375 "
Length of dam top	680 "

Supposing that the ground would have to be excavated to a depth of ten feet at the side and bottom, the contents would be 26,500 cubic yards, estimating this at a cost price of six dollars per cubic yard the cost would be $159,000.

Estimated Cost of Plant.

Cost of dam	$159,000
Cost of wheel plant	61,985
Cost of electrical equipment	28,175
Total cost of plant	249,160
Cost per horse-power in bringing water to turbine	$141 09
" " of wheel plant	55 00
" " electrical equipment	25 00
Total cost per horse-power per annum	221 09

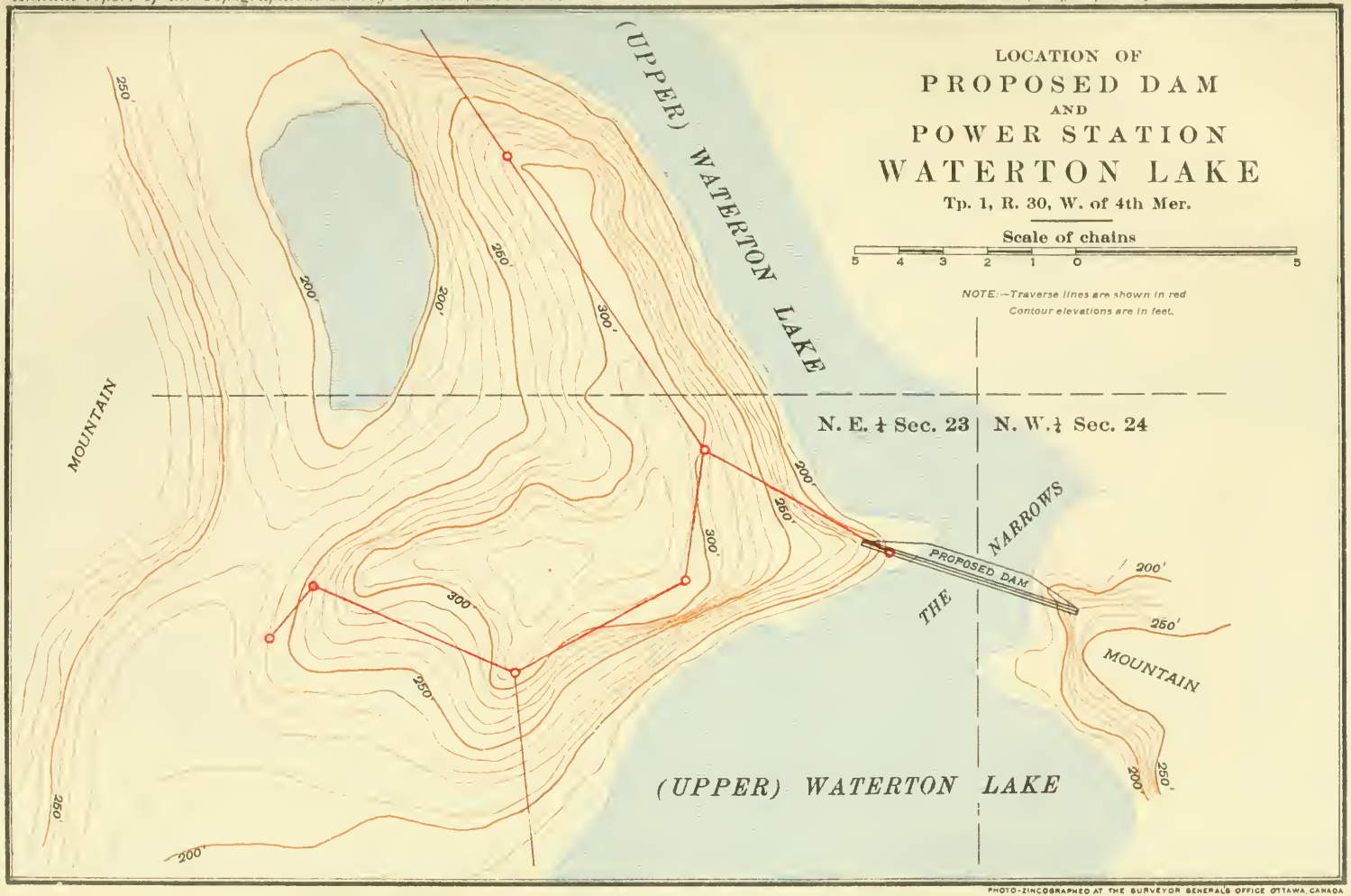
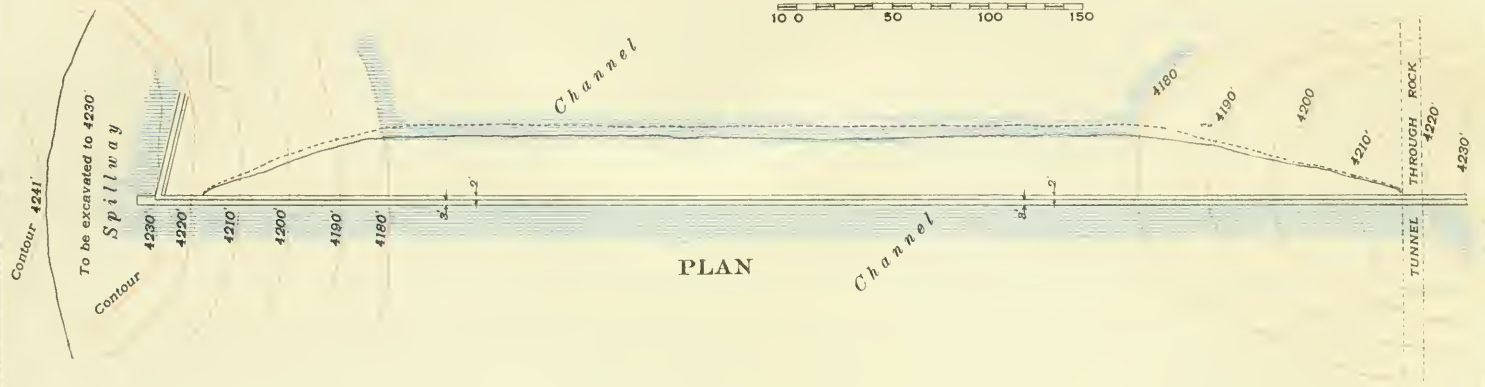


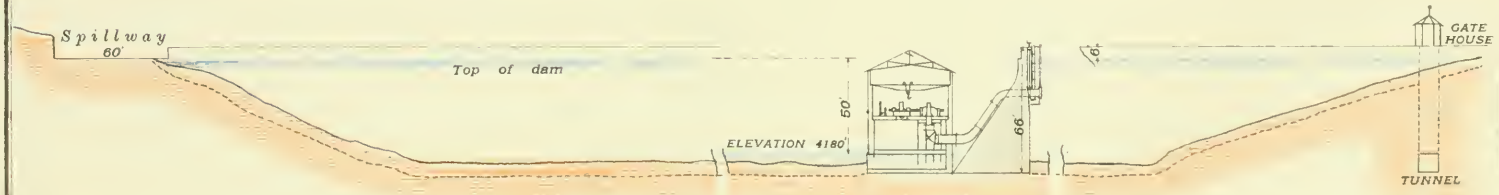
PHOTO-ZINCOGRAPHED AT THE SURVEYOR GENERAL'S OFFICE OTTAWA, CANADA

PRACTICAL DIAGRAM
OF
PROPOSED DAM AND POWER STATION
AT THE NARROWS
WATERTON LAKE

Scale of feet
10 0 50 100 150



PLAN



ELEVATION CROSS SECTION
of Dam and Power Station

PHOTO-ZINCOGRAPHED AT THE SURVEYOR GENERAL'S OFFICE OTTAWA CANADA

Placing depreciation on whole plant at	2 per cent.
Repairs	1 "
Interest	6 "
Taxes and insurance	1 "
Total	10 "

Cost of Operation.

Fixed expenses per horse-power, $221·00 at 10%	$22 10
Running expenses	2 00
Total cost per horse-power per annum (24 hr. day)	$24 10

The power could be transmitted to Cardston, Pincher and other towns, but there are other more economical water-power propositions available for those places. Considering the dam from an irrigation point of view, it will be found that the run off at flood level in spring and fall could be collected in the reservoir thus formed, avoiding floods, and adding 340 foot seconds or 126,000 acre feet per irrigation season of six months, thus more than doubling the capacity of the river for irrigation purposes.

WATERTON RIVER.

Gauging made October 16, 1908.

Gurley meter No. 617.

Discharge 503 foot seconds. Total area, 257 sq. ft.

Sounding.							
Distance from zero point.	Depth.	Depth of Observation.	Revolution.	Second.	Velocity feet per second.	Discharge per section.	—
10	1·2	$\frac{6}{10}$	50	47·0	2·47	28·16	
15	1·7	.....	50	35·2	3·29	27·60	
20	1·7	.....	50	35·8	3·32	28·01	
25	1·6	.....	50	36·0	3·21	25·70	
30	1·6	.....	50	41·8	2·75	22·00	
35	1·6	.....	50	48·0	2·42	19·36	
40	1·6	.....	50	55·3	2·10	16·80	
45	1·3	.....	30	53·4	1·33	16·80	
50	1·0	.....	.....	.....	.....	.....	
60	0·6	.....	20	24·0	0·41	2·17	
65	0·0	.....	0	0.0	.....	.....	Island.
10	0·6	.....	.....	.....	0·88	8·81	
20	1·0	.....	30	54·2	1·30	18·98	
30	1·5	.....	30	54·2	1·43	24·88	Waterton river.
40	1·8	.....	30	48·8	1·53	26·93	Gauged above confluence of Blakiston brook and Boulder creek.
50	1·8	.....	30	45·6	1·74	33·76	
60	2·0	.....	30	37·9	1·92	37·63	
70	2·0	.....	30	36·2	2·01	40·20	
80	2·0	.....	30	34·6	2·01	36·60	
90	1·9	.....	30	34·5	1·98	33·66	
100	1·6	.....	30	35·2	2·10	42·00	
110	1·9	.....	30	33·0	2.10	13·80	
120	6·9	.....	30	0·0	0·00	0·00	

OIL CREEK.

Estimate of cost of hydro-electric plant for 392 horse-power proposed to be erected on Oil creek in the northwest quarter of section 23, township 1, range 30, west of the fourth meridian, the intake being half a mile up the creek.

Topographical Description.

Oil creek, a tributary of Waterton lake, receives its water supply from the snow melting on the surrounding peaks. The flow varies much on this account and a hot and rainy summer might greatly diminish the water supply before fall.

At the foothills there is a fall of about thirty feet, from this point up, the creek runs through a gulch or canyon cut through solid rock, the right limit following the foothill closely; on the left there is a valley between 200 and 300 feet in width, covered with gravel and loam and containing some timber, principally spruce, between ten and fourteen inches in diameter, to the place of intake. The country in the vicinity is of no value for farming and of very little value for grazing.

From the falls up the creek there are a series of cascades. The strike is east and west; dip southerly at 20°.

Survey.

The survey of the water-power was connected with the southeast corner of section 35, township 1, range 30.

It was found in plotting that some mistake had been made in reading the distance or angle of some course or in entering the reading in the note-book which was done by my assistant. The section lines are shown only approximately, but the mill site is well within the area reserved for that purpose.

The levels were connected with the Canadian irrigation survey, Waterton lake, elevation 4,186 feet.

The land to be reserved for mill site is the southwest quarter of section 23, township 1, range 30.

Drainage Basin.

The drainage basin of Oil creek is about twelve square miles.

Maximum and Minimum Flow.

The maximum and minimum flow is very uncertain as there are few data.

August 18, 1908, I explored Oil creek and estimated the volume of water to be from fifty to sixty foot seconds.

Gauging.

September 4, 1908	1,437	foot seconds.*
October 16, 1908	96	" " †

At the foot of the falls the elevation is 4,186 feet and at the point of intake 4,443 feet making a difference in elevation of 257 feet.

The water from the intake to the falls would have to be carried in a stave pipe twenty-seven inches in diameter, half a mile long, grade ten feet per mile, velocity four feet per second, flow sixteen foot seconds. Deducting grade of pipe (seven feet) there remains an effective head at the falls of two hundred and fifty feet which would generate 392 horse-power, figuring the minimum flow at fourteen foot seconds.

Location of Mill Site.

The proposed mill site is located at the foot of the falls about twenty-eight miles from Cardston and thirty-four miles from Pincher, the two nearest railway stations; the roads are fair.

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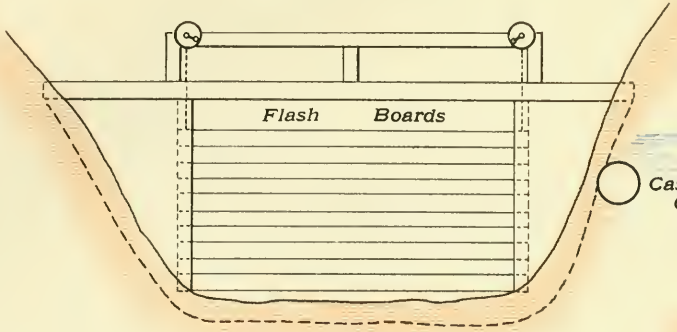
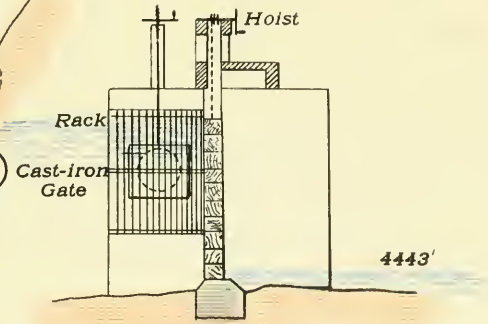
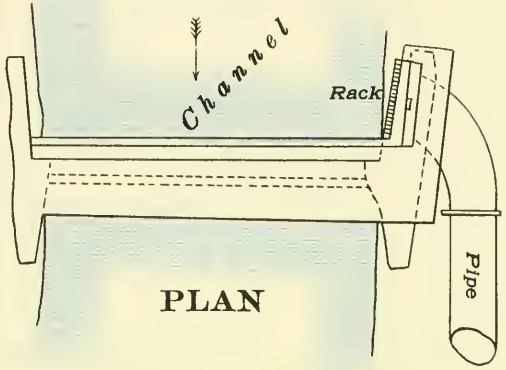
* Canadian Irrigation Surveys.—†Thibaudeau.

ELEVATION





SECTION



PLAN

INTAKE
OIL CREEK

Scale of feet.

5 0 5 10 15 20

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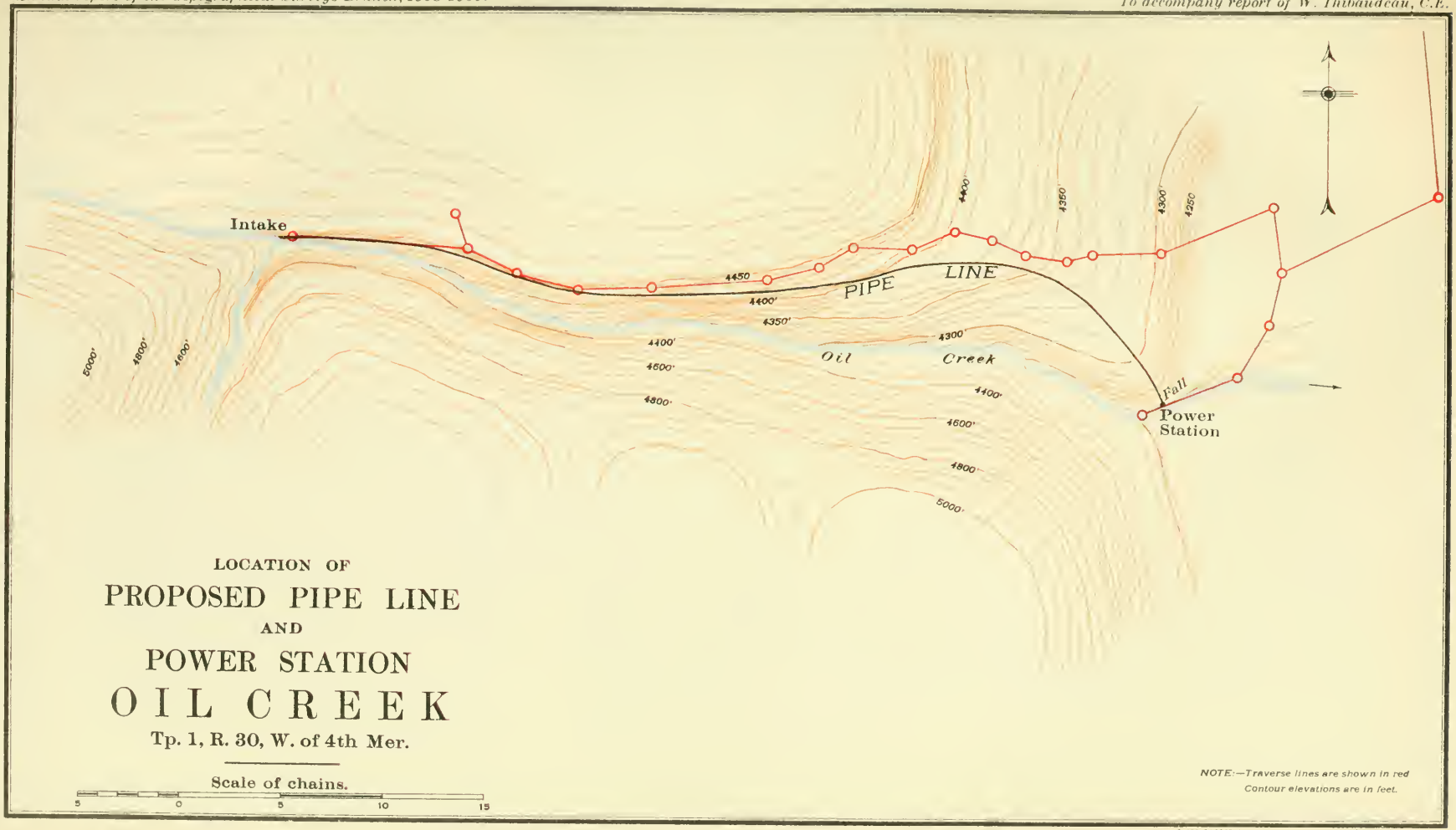


LOCATION OF

PROPOSED PIPE LINE

AND

POWER STATION

OIL CREEK

Tp. 1, R. 30, W. of 4th Mer.

Scale of chains.

5 0 5 10 15

NOTE:—Traverse lines are shown in red
Contour elevations are in feet.

PHOTO ZINCOGRAPHED AT THE SURVEYOR GENERAL'S OFFICE OTTAWA CANADA

Freight rate from Cardston about.. .. .. $ 9 00 per ton.
" " Pincher.. " .. .. 12 00 "

Estimated Cost of Plant.

Intake—	
Masonry, 60 cubic yards at $6..	$360 00
Timber, 4,500 feet B.M., at $38..	171 00
Total..	$531 00
Pipe 27 inch diameter at $1.90 per lineal foot or $10,032 per mile for one half mile..	$ 5,016
1,800 cubic yards excavation for pipe at 50 cents..	900
Wheel plant..	19,600
Electrical equipment..	11,760
Total cost..	$37,807
Cost per horse-power bringing water to turbine..	$16 44
" " of wheel plant..	50 00
" " electrical equipment..	30 00
Total cost per horse-power..	$96 44
Placing depreciation on whole plant at..	2 per cent.
Repairs..	1 "
Interest..	6 "
Taxes and insurance..	1 "
Total..	10 "
Fixed expenses per horse-power, $96.44 at 10 p.c..	$ 9 64
Running " "	2 00
Total cost per horse-power per annum (24 hr. day)..	11 64

A part of this cheap power might be developed and utilized in the construction of a reservoir for irrigation purposes on the Waterton lake or river. In addition to this it could be used for prospecting the oil fields for which the geological conditions are favourable.

Gauging made October 16, 1908.

Gurley meter No. 617.

Discharge 96 cubic feet per second. Total area, 3,809 feet.

Sounding. Distance from zero point.	Sounding. Depth.	Depth of Observation.	Revolution.	Second.	Velocity feet per minute.	Discharge per section.	—
0	.....	6/10	.....	.....	.....	.....	
6	1·3	.....	50	47·0	2·47	18·40	
11	1·4	.....	50	34·6	3·44	22·00	
16	1·3	.....	50	42·0	2·75	17·87	
21	1·4	.....	50	44·0	2.63	17·75	
26	1·3	.....	40	47·5	2·02	15·76	
31	0·7	.....	.....	0	.....	.....	
36	0·5	.....	40	56·0	1·48	4·59	
41	0·0	.....	0	0·0	.....	.....	Oil creek, gauged about 150 yards below the fall.

BLAKISTON BROOK.

Estimate of cost of a hydro-electric plant for 712 horse-power proposed to be erected in the northeast quarter of section 6, township 2, range 29, west of the fourth meridian.

Topographical Description.

Blakiston brook, a tributary of Waterton lake, receives its water supply from the snow melting on the surrounding peaks. The valley is narrow averaging about a quarter of a mile in width and running in a westerly direction; the right limit of the brook follows the foothill closely, while the left side consists of benches.

From the foothill to the place of intake there are no streams or gulches through the valley which would cause trouble in the construction of a canal. For half a mile from the intake the brook runs through solid rock formation, the remainder of its course to Waterton lake is partly through gravel and partly through rock. On the north side of the brook the valley and foothills are open and covered with loam and gravel; in a few places towards the intake there are slate rock outcroppings and there is good grazing all through the valley.

On the south side the foothills are timbered with small spruce and pine averaging six inches in diameter.

The brook at flood level is a torrent but carries no driftwood.

The valley on the north side to lower Waterton lake is regular in slope; the soil is loam, and is well adapted for canal purposes.

SURVEY.

The survey of the water-power was connected with the northeast corner of section 5, township 2, range 29, the corner post being 19·45 chains north of station 3.

The levels were connected with the Canadian irrigation survey, lower Waterton lake, elevation 4,150 feet.

The land to be reserved for mill site is the east half of section 6, township 2, range 29.

Drainage Basin.

The drainage basin of Blakiston brook is about fifty-eight square miles and extends to the head of the south Kootenay pass on the continental divide.

Minimum Flow.

On August 20, 1908, I explored the brook and estimated the flow at fifty foot seconds.

October 16, 1908, I gauged the brook and found the discharge to be eighty-five foot seconds.

From its drainage basin compared with Waterton river and local conditions I believe it safe to estimate the minimum flow at forty foot seconds. To date there is no available data from which the minimum flow may be determined.

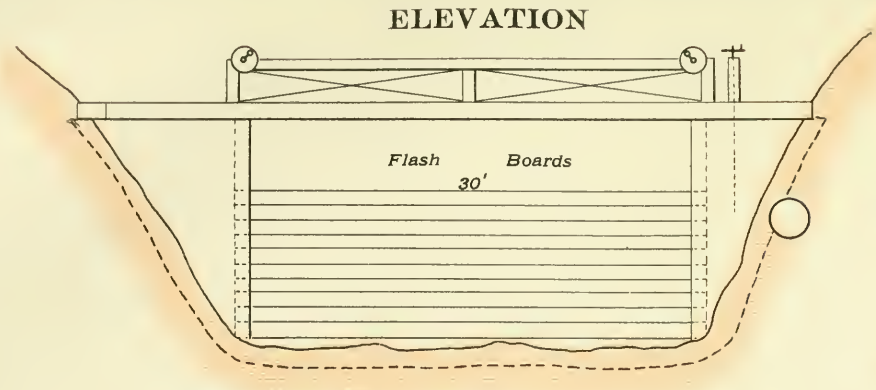
Location of Power Plant.

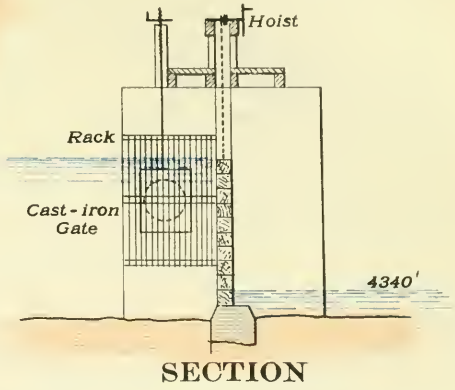
The proposed power plant is located on the west shore of the lower Waterton lake twenty-three miles from Cardston and thirty-two miles from Pincher, the two nearest railway stations. The roads are fair.

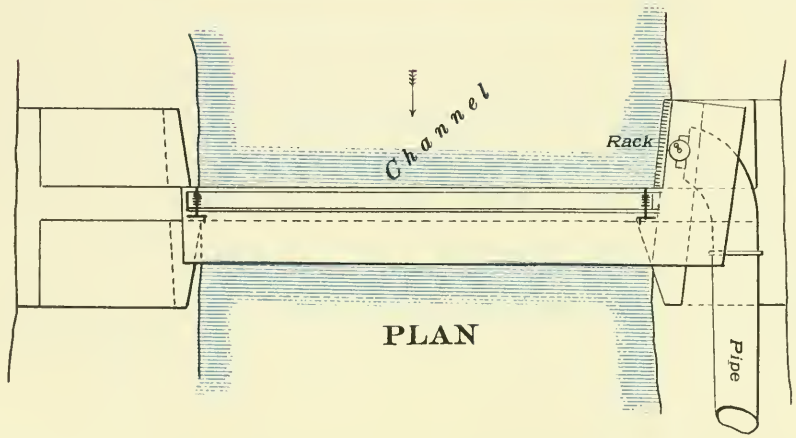
Freight rate from Cardston about.. .. .. $ 8 00 per ton.
" " Pincher " .. .. 11 00 "

Good building material can be obtained in the vicinity; there is also a saw-mill close by.

I propose to bring the water through pipes and canal to the wheel plant.







INTAKE
BLAKISTON BROOK

Scale of feet.

5 0 5 10 15 20

PHOTO-ZINCOGRAPHED AT THE SURVEYOR GENERAL'S OFFICE OTTAWA, CANADA

NOTE:—Traverse lines are shown in red
Contour elevations are in feet.

LOCATION OF

PROPOSED CANAL, PIPE LINE AND POWER STATION BLAKISTON BROOK

Tp. 2, R. 29 and 30, W. of 4th Mer.

Scale of chains.

10 0 50 100

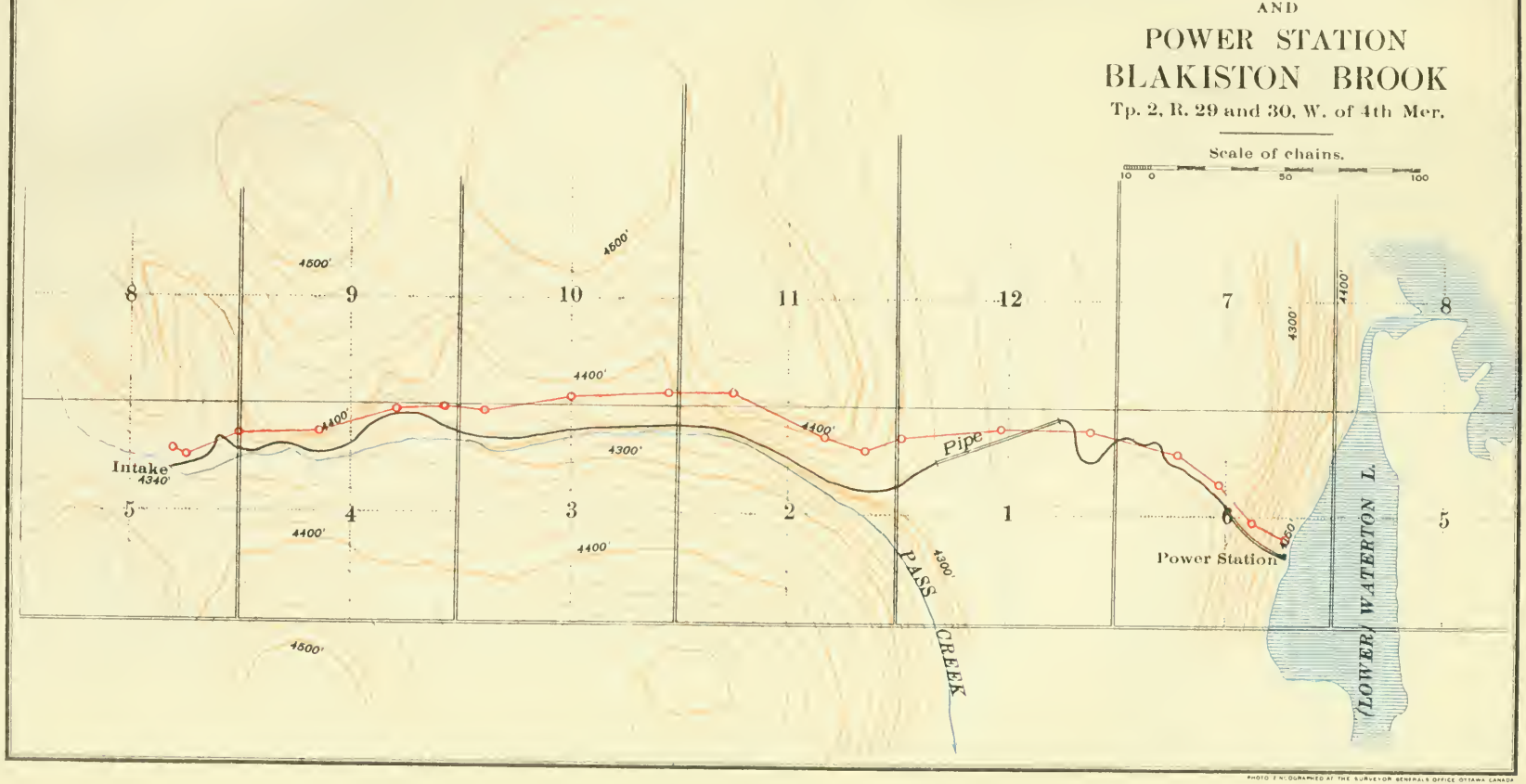


PHOTO ENGRAVED AT THE SURVEYOR GENERAL'S OFFICE OTTAWA CANADA

Estimated Cost of Canal and Pipe.

It would require four miles of canal, bottom two feet, slopes 1-1, depth of water 3·5 feet, height of bank five feet, grade per mile four feet, velocity 2·1 feet per second, volume of water forty-one foot seconds. This canal would require the excavation of 3,300 cubic yards per mile at 50 cents per cubic yard, $1,650 per mile. Total cost for four miles, $6,600.

Pipe.

It would require one mile of stave pipe 36 inches in diameter; grade 16 feet per mile, velocity 6 feet per second, flow 42 second feet, price $2.30 per foot, $12,144 per mile.

Estimated Horse-power.

The elevation at the intake is 4,340 feet and at the power house it is 4,150 feet, making a difference in elevation of 190 feet; deducting grade of canal and pipes, thirty-two feet, there remains an effective head of one hundred and fifty-eight feet, giving 712 horse-power.

Estimated Cost of Plant.

Intake—		
Masonry, 80 cubic yards at $6		$ 480 00
Timber, 7,500 feet B.M., at $36		270 00
Total		$ 750 00
Canal		6,600 00
Pipes		12,144 00
Excavation for pipes, 1,800 cubic yards at 50c		900 00
Wheel plant		35,600 00
Electrical equipment		21,360 00
Total cost		$77,354 00
Cost per horse power in bringing water to turbine		28 65
" " " " of wheel plant		50 00
" " " " electrical equipment		30 00
		$ 108 65
Placing depreciation on whole plant at	2%	
Repairs	1%	
Interest	6%	
Taxes and insurance	1%	
Total	10%	
Fixed expenses per horse-power, $108.65 at 10%		10 86
Running " " "		2 00
Total cost per horse-power per annum (24 hr. day)		$ 12 86

It is possible that a small canal would give some trouble in the winter time; in that case it could be replaced by pipe which would reduce the horse-power to 495.

Cost of Plant, all Pipe.

Intake	$ 750 00
Pipe 5 miles at $12,144 per mile	60,720 00
Excavation for pipes 9,000 cubic yards, 50c	4,500 00
Wheel plant	24,750 00
Electrical equipment	14,850 00
Total cost	$105,570 00
Cost per horse-power in bringing water to turbine	$ 133 27
" " " " of wheel plant	50 00
" " " " electrical equipment	30 00
Total cost per horse-power	$ 213 27

Placing depreciation on whole plant at	2%
Repairs	1%
Interest	6%
Taxes and insurance	1%
Total	10%

Fixed expenses per horse-power, $213.27 at 10%	$ 21 33
Running " " "	2 00
Total cost per horse-power per annum (24 hr. day)	$ 23 33

Gauging made October 16, 1908.

Gurley Meter No. 617.

Discharge 85·10 second feet. Total area 58 square feet.

Sounding. Distance from zero point.	Sounding. Depth.	Depth of Observation.	Revolution.	Second.	Velocity feet per minute.	Discharge per section.	—
0	0	6/10	0	.....	.....	.....	
5	1·5	6/10	·30	72	0·99	7·87	
10	2·1	6/10	30	53	1·33	13·70	
15	2·3	6/10	30	40	1·74	19·58	
20	2·1	6/10	30	37	1·88	19·93	
25	2·0	6/10	30	41·4	1·68	16·80	
30	1·6	6/10	20	52	1·14	7·22	
35	0·0	6/10	.....	.....	.....	.....	Blakiston brook, gauged about half a mile up from its mouth.

BOULDER CREEK.

Gauging made October 16, 1908.

Gurley Meter No. 617.

Discharge 29·01 second feet. Total area 14 square feet.

Sounding.		Depth of Observation.	Revolution.	Second.	Velocity feet per minute.	Discharge per section.	—
Distance from zero point.	Depth.						
0	0	6/10	.....	.. ..	.....	.....	
1·3	0·3	.....	.....	.....	.....	.....	
3·3	0·6	.....	30	55·5	1·95	4·39	
5·3	0·8	.....	.....	.....	.....	.....	
7·9	1·4	. ..	50	38·5	3·00	15·30	
10·6	1·2	.....	30	37·5	1·95	4·39	
13·2	0·8	.....	30	63·2	1·12	2 18	
15·8	0·8	.....	20	42·5	1·10	2·75	
20·5	.. . ..	.. ..	.....	.....	.....	.....	Boulder creek, gauged one mile above its mouth.

SOUTHFORK RIVER.

Estimate of cost of hydro-electric plant for 2,700 H. P. proposed to be erected in the northwest quarter of section 24, township 6, range 2, west of the fifth meridian.

Topographical Description.

The canyon of Southfork river is two hundred feet in depth, and cuts through an open plateau whose altitude is 3,970 feet; the bottom and banks are of solid sandstone which is visible nearly everywhere. It begins about the centre of the southeast quarter of section 9 and extends to Canyon creek from which the valley of the Southfork runs in a southeasterly direction for five or six miles, and consists of rolling slopes partly timbered and partly open prairie; the valley is broken in places by hills and averages half a mile in width and is partly under cultivation. The best location for a dam is in the northwest quarter of section 24, township 6, range 2. Through the canyon the strike is about north and south and dips easterly at about 30°.

Survey.

The survey of the water-power was connected with the northeast corner of section 13, township 6, range 2.

The levels were connected with the Canadian irrigation survey bench mark 98, elevation 4,031 ; on the plan 177 feet should be added to all elevations given.

The lands to be reserved for mill site are the north half of the northeast quarter of section 13 and the south half of the southeast quarter of section 24, township 6 range 1.

Drainage Basin.

The drainage basin of Southfork river at the proposed mill site is 285 square miles, extending to the continental divide in a southwesterly direction.

Minimum and Maximum Flow.

From the data at my disposal I would estimate the minimum flow to be about 200 foot seconds and to occur between April 1 and 15 and September 5 and 20. The high water mark at flood level last year was eleven feet above the ordinary level.

Gauging.

July 10, 1908	Discharge	1,327	foot seconds	Canadian irrigation surveys—Thibaudeau.
July 18, 1908	"	859	"	
August 21, 1908	"	235	"	
October, 26, 1908	"	256	"	

Location of Dam.

The proposed dam is about nine miles from Cowley; the freight rate would be three dollars per ton. The elevation of highway bridge floor which is situated about half a mile above the proposed dam, is 3,765 feet.

Estimate of Cost of Masonry Dam.

	Feet.
Height of dam	120
Length of dam bottom	66
Length of dam top	160

Supposing the ground would have to be excavated to a depth of ten feet at the side and bottom, the cubic contents would be 29,000 cubic yards; estimating this at $6.00 per cubic yard—$174,000.

Estimated Cost of Plant.

Masonry dam	$174,000 00
Wheel plant	148,500 00
Electrical equipment	75,600 00
Total cost	398,100 00
Cost per horse-power in bringing water to turbine	$64 44
Cost per horse-power of wheel plant	55 00
Cost per horse-power electrical equipment	28 00
Total cost per horse-power	147 44

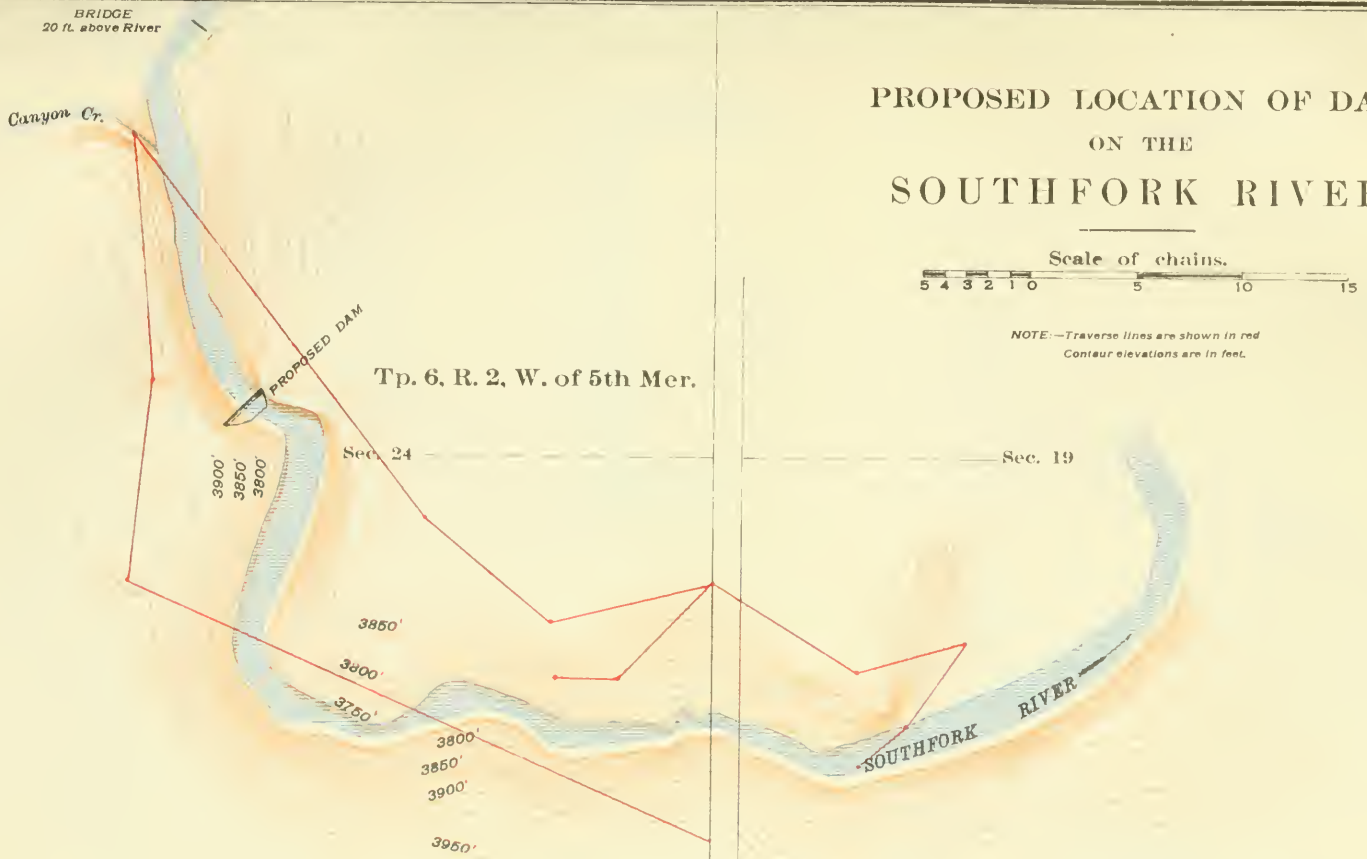
Cost of Operation.

	Per Cent.
Placing depreciation on whole plant at	2
Repairs	1
Interest	6
Taxes and insurance	1
	10

Cost of Operation.

Fixed expenses per H. P. $147.44 at 10 per cent	$14 74
Running expenses per H. P.	2 00
Total cost per H.P. per annum (24 hr. day)	16 74

PROPOSED LOCATION OF DAM
ON THE
SOUTHFORK RIVER

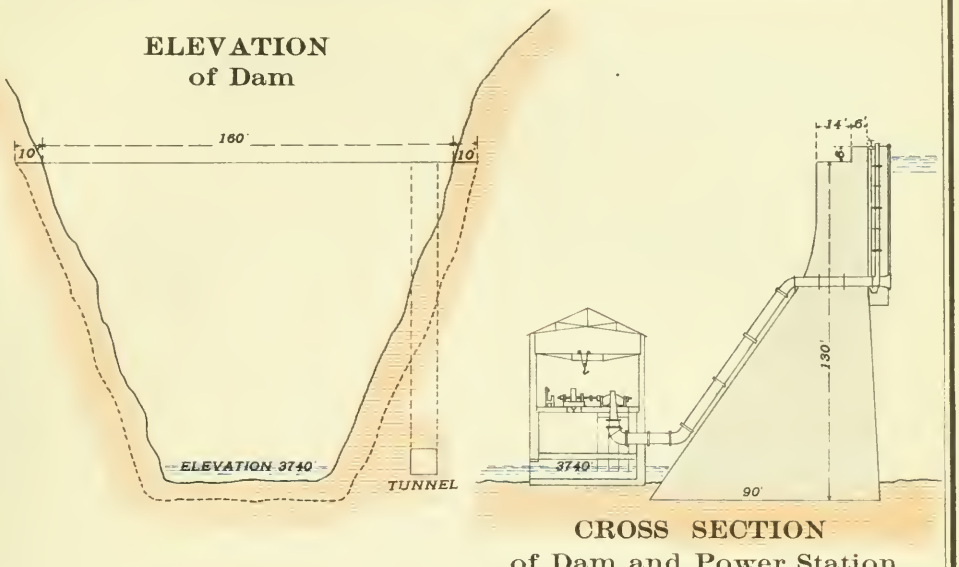


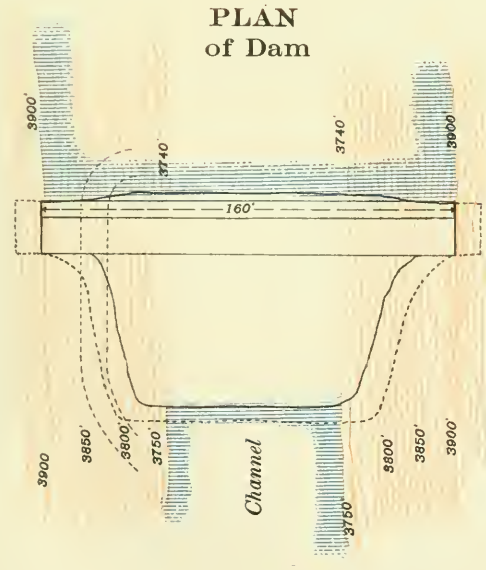
Scale of chains.

5 4 3 2 1 0 5 10 15

NOTE:—Traverse lines are shown in red
Contour elevations are in feet.

PHOTO ZINCOGRAPHED AT THE SURVEYOR GENERAL'S OFFICE OTTAWA CANADA





PRACTICAL DIAGRAM

OF

PROPOSED DAM AND POWER STATION

SOUTH FORK RIVER

Scale of feet

10 0 50 100 150

PHOTO-ZINCOGRAPHED AT THE SURVEYOR GENERAL'S OFFICE OTTAWA, CANADA

The mill is situated in the middle of a large coal basin, and Cowley, Lundbreck, Pincher Creek and Pincher, with their elevators, flour mills. &c., would be within easy reach of the power plant. At present steam is the only source of power for these places.

Gauging made October 24, 1908.

Gurley Meter No. 617.

Discharge 256 foot seconds. Total area 119 square feet.

Sounding.		Depth of Observation.	Revolution.	Second.	Velocity feet per minute.	Discharge per section.	—
Distance from zero point.	Depth.						
0	0	6/10	0	0	0	0	
10	0	.....	... ..	.....	.....	.....	
15	·40	.....	30	47·5	1·46	6·42	
20	1·00	.....	30	45·0	1·55	10·85	
30	1·20	.....	50	57·0	2·02	24·64	
40	1·50	.....	50	48·5	2·40	35·04	Southfork river gauged above confluence of Canyon creek.
50	1·60	.....	50	51·0	2·27	36·32	
60	1·50	.....	50	42·0	2·75	44·55	
70	2·00	.....	50	45·0	2·57	50·37	
80	1·80	.....	50	60·6	1·92	32·64	
90	1 10	.....	30	53·0	1·33	15·42	
100	0 00	.....	0	0·00	... .	..... .	

MILL CREEK.

Gauging made October 24, 1908.

Gurley Meter No. 617.

Discharge 37·82 foot seconds. Total area 38 square feet.

Sounding.		Depth of Observation.	Revolution.	Second.	Velocity feet per second.	Discharge per section.	—
Distance from zero point.	Depth.						
0	0	6/10	0	0	.....	.....	
5	1·3	... .	20	83·0	0.59	3·85	
10	1·8	.....	20	68·2	0.71	6·30	Mill creek gauged 300 yds. above its mouth.
15	2·1	.....	30	49·5	1.44	14·40	
20	1·8	.....	30	53·0	1.31	11·10	
25	1·0	.....	10	45·0	0.55	2·23	
31	0·0	.....	0	0	.....	37·88	

CROWSNEST RIVER.

Estimate of cost of a hydro-electric plant for 630 H. P. proposed to be erected at the foot of the falls of Crowsnest river in the southeast quarter of section 28, township 7, range 2, west of the fifth meridian.

Topographical Description.

The Crowsnest river valley is well defined, consisting of rolling slopes interspersed in places with mountains; it is free from cut banks and is partly timbered and partly open prairie; it is most picturesque in appearance, averaging about three-quarters of a mile in width; the water is clear and cold. The banks of the river seldom exceed ten or twelve feet in height.

There is a fault in the hard sandstone formation which produces the falls, the country rock below and above the falls lies practically horizontal. The Canadian Pacific railway follows the river at an elevation of about fifteen feet above high water mark.

The rock formation in general is of sandstone and limestone.

The river carries no driftwood.

The site of the falls is as cheap as could be found for generating power. Coal mining and mixed farming are the principal occupations of the settlers.

The survey of the mill site was connected with the northeast corner of section 21, township 7, range 2.

The levels were connected with the Canadian Pacific railway bridge, elevation 3,784 feet.

The lands to be reserved for mill site are the west quarter of the southeast quarter of section 27, and the east half of the southeast quarter of section 26, township 7, range 2.

Drainage Basin.

The drainage basin of Crowsnest river is two hundred and sixteen square miles from the mill site, and extends to the head of Crowsnest Pass.

Minimum Flow.

From the available records at my disposal the minimum flow (140 foot seconds) appears to occur between April 1 and 15 and September 15 and October 1. There are no indications to show that the high water mark at flood level is very much above the ordinary level, the Canadian Pacific railway track being in some places within ten feet of ordinary level.

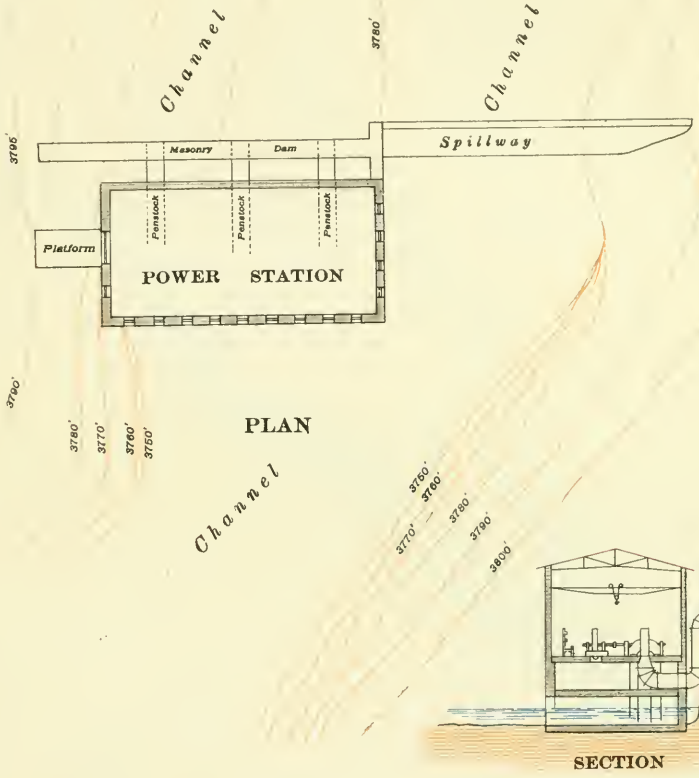
Gauging.

FROM CANADIAN IRRIGATION SURVEY.

September 7, 1907.. ..257	foot seconds	From Canadian irrigation survey.
July 11, 1908.. 532	"	
August 14, 1908.. 177	"	
August 18, 1908.. 310	"	
September 10, 1908 150	"	
September 16, 1908.. ..146	"	
October 26, 1908.. 148	"	Thibaudeau.

Location of Dam.

The proposed dam is situated about two and one-half miles from Cowley station and is close to the Canadian Pacific railway track; it will raise the water within sixteen feet of the railway bridge where track elevation is 3,793 feet, or three feet above the ordinary level. Building material, lumber and stone could be secured in the vicinity.



PRACTICAL DIAGRAM
OF
PROPOSED DAM AND POWER STATION
AT THE
FALLS, CROWSNEST RIVER

Scale of feet

10 0 50 100

PHOTO-ZINCOGRAPHED AT THE SURVEYOR GENERAL'S OFFICE OTTAWA CANADA

PROPOSED LOCATION OF DAM
CROWSNEST RIVER FALLS
Tp. 7, R. 2, W. of 5th Mer.

Scale of chains.

5 4 3 2 1 0 5 10 15

NOTE:—Traverse lines are shown in red
Contour elevations are in feet.

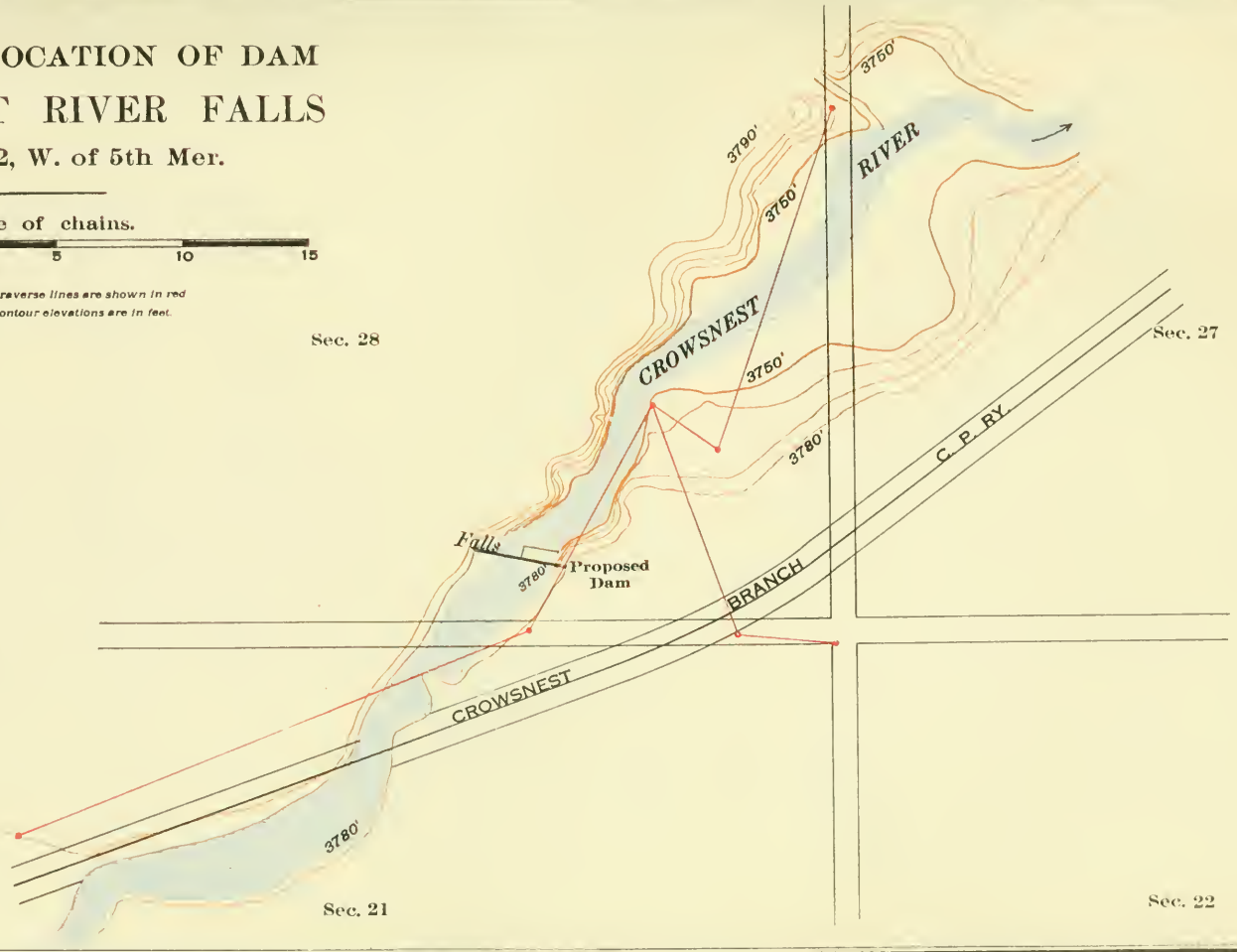


PHOTO-ZINCOGRAPHED AT THE SURVEYOR GENERAL'S OFFICE OTTAWA, CANADA

Estimated Cost of Dam.

Height of dam	9 feet
Length of dam bottom	165 "
Length of dam top	250 "
Cubic contents of dam, 800 cub. yds. at $6	$4,800.00

Estimated Horse-power.

Dam 9 feet and natural fall 31 feet, making a total fall of 40 feet with a minimum flow of 140 foot seconds, gives 630 horse-power.

Estimated Cost of Plant.

Cost of dam	$ 4,800
Cost of wheel plant	31,500
Cost of electrical equipment	18,900
Total cost	$55,200

Cost per horse-power in bringing water to turbine	$ 7.62
" " of wheel plant	50.00
" " electrical equipment	30.00
Total cost per horse-power	87.62

Placing depreciation on whole plant at	2 per cent.
Repairs	1 "
Interest	6 "
Taxes and insurance	1 "
Total	10 "

Cost of Operation

Fixed expenses per horse-power, $87.62 at 10 per cent	$ 8.76
Running expenses	2.00
Total cost per horse-power per annum (24 hr. day)	10.76

This plant would be situated in the heart of a vast coal basin twelve miles from Frank and two and one-half miles from Lundbreck coal mines.

Gauging made October 26, 1908.

Gurley Meter No. 617.

Discharge 142·9 cubic feet per second. Total area 137 square feet.

Sounding.		Depth of Observation.	Revolution.	Second.	Velocity feet per second.	Discharge per section.	
Distance from zero point.	Depth.						
0	0	6/10	0	0	0	.....	
10	2.14	"	20	78.5	0·619	12·75	
20	2.10	"	20	42.2	1·11	23·31	Crowsnest river gauged at ford below C.P.R. bridge.
30	1·95	"	20	40·0	1·17	23·40	
40	2·00	"	20	40·8	1·16	23·20	
50	1·85	"	20	38·1	1·23	22·63	
60	1·60	"	20	40·5	1·16	16·39	
70	1·10	"	20	50·0	0·95	0·85	
80	0·85	"	20	52·8	0·93	8·0	
90	0·50	"	20	59·0	0·81	3·4	
100	·00	"	0	0	0		
						133·93	

GOLD CREEK.

On August 29, 1908, I explored the creek and found the flow to be about forty-five foot seconds and as the barometer indicated a good fall per mile. I decided to return and make an instrumental survey of the creek.

On October 31, I commenced the survey; although it was the season of high water, the flow was found by gauging to be only thirty foot seconds. There are no snow peaks in the vicinity to aliment the flow; the drainage basin is very limited and conditions are favourable for a quick run off. The creek valley is about two hundred or three hundred yards in width.

Taking into consideration, local conditions and the fact that the town of Frank obtains its water supply from that creek, it was apparent that very little power could be developed and that not on a commercial basis, so I stopped the survey.

I have the honour to be, sir,
Your obedient servant,

W. THIBAUDEAU,
Civil Engineer.

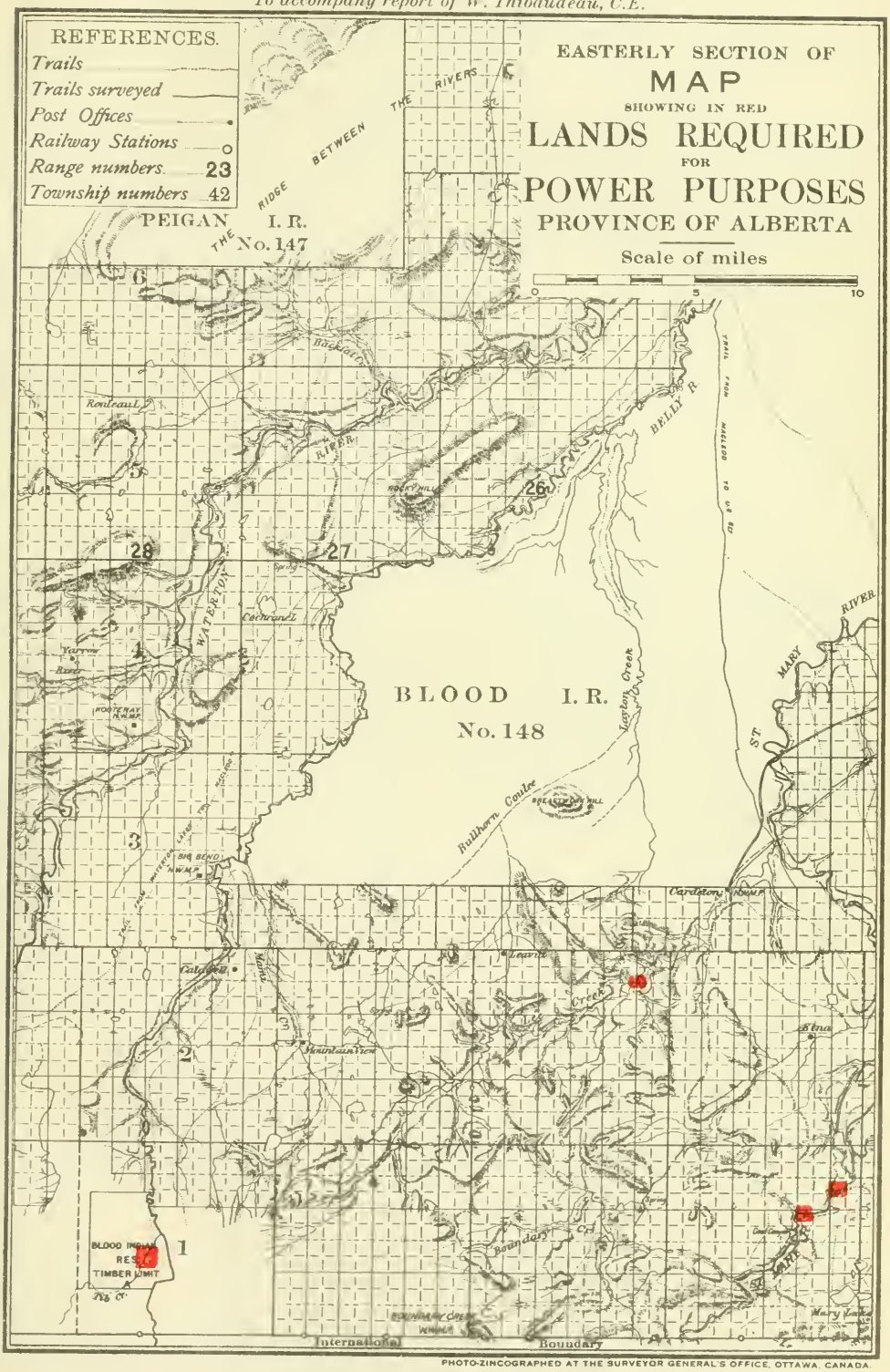


PHOTO-ZINCOGRAPHED AT THE SURVEYOR GENERAL'S OFFICE, OTTAWA, CANADA.

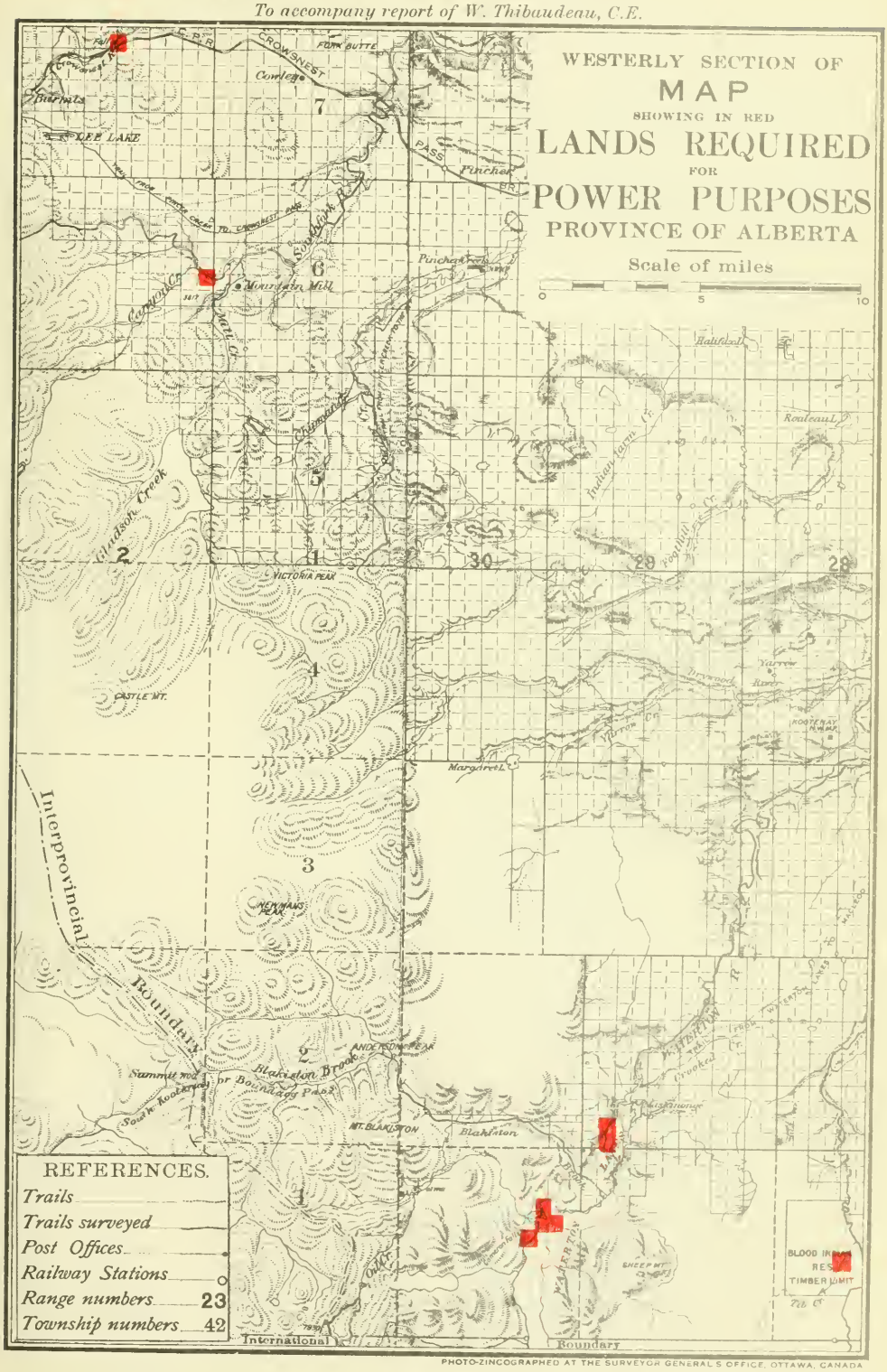


PHOTO-ZINCOGRAPHED AT THE SURVEYOR GENERAL'S OFFICE, OTTAWA, CANADA

DEPARTMENT OF THE INTERIOR—CANADIAN IRRIGATION SURVEYS.

DISCHARGE MEASUREMENTS AT REGULAR STATIONS.

On Crowsnest river at bridge on northeast quarter of section 26, township 7, range 2, west of the fifth meridian near Lundbreck post-office, province of Alberta.

Number.	Date.	Hydrographer.	Meter Number.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge.	Remarks.
1	Sept. 7, '07..	I. J. W...	26	55	106	2·43	25	257 1	
2	July 11, '08..	H. C. R..	26	64	131·35	4·03	2·717	532·2	
3	Aug. 14, '08..	H. R. C..	26	53·5	78·9	2·25	1·80	172·3	
4	" 18, '08..	H. R. C..	26	59·	103·9	2·99	2·28	310·82	
5	Sept. 10, '08..	H. C. R..	82	52	76·42	1·97	1·70	150·5	
6	" 16, '08..	H. C. R..	82	52	72·87	1·97	1·70	146·04	

On Oldman river, at cable station on northeast quarter of section 34, township 7, range 1, west of the fifth meridian near Cowley post-office, province of Alberta.

1	Sept. 6, '07..	.....	26	185	246·8	3·1	2·55	766·3	
2	July 14, '08..	.....	26	181	310·83	3·99	2·50	1,242·96	About 20% too high.
3	Aug. 13, '08..	.....	26	177·5	175·1	2·27	183·5	397·0	
4	" 19, '08..	.....	26	161·0	150·0	2·02	169·5	303·2	
5	Sept. 15, '08..	.....	82	115·0	104·68	1·62	150·0	170·18	

On Oldman river, at Naffia bridge near Macleod post-office, province of Alberta.

1	July 25, '06..	.....	26	250	447·5	5·75	2·3	1,229·6
2	" 31, '06..	.....	26	230	398·1	2·60	2·1	1,013·9
3	Oct. 2, '06..	.....	26	206	267·2	1·98	1·55	528·4
4	June 25, '07..	.....	26	364·7	1,709·3	6·27	6·00	10,722·4
5	Sept. 14, '07..	....	26	295	583·8	2·69	2·55	1,569·2
6	" 20, '07..	.....	26	307·0	924·7	3·24	3·47	2,994·3

On Waterton river, at Waterton Mills near Waterton Mills post-office, province of Alberta.

1	Sept. 10, '06..	J. F. H ..	26	289	219·66	2·01	.....	442·21
2	" 20, '07..	I. J. W...	26	293	619·30	3·51	4·1	2,176·8
3	" 5, '08..	H. C. R..	82	227	159·26	1·29	2·5	205·13
4	" 18, '08..	H. R. C..	26	210·5	172·3	1·38	2·49	237·7

On St. Mary River, at Cable station above A. R. & I., headgate near Kimball post-office, province of Alberta.

1	Sept. 22, '06..	... .	26	224	264·3	1·92	....	508·1
2	Aug. 3, '07..	.....	26	230	502·9	4·03	4·2	2,026·0
3	June 29, '08..	.....	26	229	744·5	3·81	34·13	2,836·98
4	Sept. 1, '08..	.....	82	219	324·2	1·60	2·50	519·22
5	" 16, '08..	....	26	219	339·0	1·71	2·50	519·80

On Southfork river.

Number.	Date.	Hydrographer.	Meter Number.	Width.	Area of section.	Mean velocity.	Gauge height.	Discharge.	Remarks.
1	July 10, '08..	.....	26	204·7	415·03	3·20	.....	1,327·83	B. M. 11·75 above water line. B. M. 1,225 but still water not added in area of discharge.
2	" 18, '08..	.....	26	137·3	225·7	3·81	.....	859·11	

On Oldman river, north of Pincher.

1	July 15, '08..	H. C. R..	26	287	828·88	3·23	.....	2,671·99	

On Lee creek.

1	Sept. 2, '08..	.....	82	132	7·65	1·76	.....	13.47	
2	" 15, '08..	.....	26	215	14·42	0·79	.....	11·38	

On Oil creek.

1	Sept. 4, '08..	.....	82	15·0	10·87	132	.....	14·37	

On A. R. & I. flume, over South Willow creek.

1	Sept. 1, '08..	.....	82	27	51.3	3·69	1·90	189·45	
2	" 16, '08..	....	26	27	79.65	5·16	2·95	440·91	

On Waterton river, province of Alberta at Royal North West Mounted Police detachment, north boundary section 20, township 5, range 27, west of the fourth meridian.

1	Sept. 26, '06..	.....	26	.....	..... .	.....	2·9	300.2	
2	Aug. 15, '07..	.....	26	..... .	.....	.....	.....	885·9	

On Belly river.

1	June 19, '08..	.....	26	95	395·0	4·09	2·70	1,616·6	Station damaged and gauging was made two miles up stream at traffic bridge near Caldwell.
2	July 1, '08..	....	26	92	290·4	3·24	2·40	939·75	Station damaged and gauging was made two miles up stream at traffic bridge near Caldwell.
3	" 28, '08..	... .	26	101 5	280·97	3·27	.....	917·55	Gauging made from traffic bridge at Standoff.
4	Sept. 14, '08..	... .	26	85·5	138·0	1·50	.....	206·7	Gauging made from traffic bridge at Standoff.

SESSIONAL PAPER No. 25b

APPENDIX No. 46.

REPORT OF J. N. WALLACE, D.L.S.

SURVEY OF THE BOUNDARY BETWEEN BRITISH COLUMBIA AND YUKON TERRITORY, FROM TATSHENSHINI RIVER TO TAKHINI RIVER.

CALGARY, ALBERTA, December 4, 1908.

E. DEVILLE, Esq., LL.D.,
Surveyor General,
Ottawa.

SIR,—I have the honour to submit the following report on the survey of part of the boundary between British Columbia and the Yukon Territory during the season of 1908, undertaken in accordance with your instructions of April 28, 1908. The part of the boundary referred to in this report is that between Tatshenshini river, near the Dalton trail, and Takhini river, a distance of nearly thirty-six miles.

About the beginning of April, I was informed that everything pointed to an unusually early opening of the season in the Yukon, and I anticipated that work could be commenced this season earlier than last, on which occasion I had left Vancouver on June 7. Unfortunately, this anticipation did not prove to be well founded, for while it was certainly a very early season in the interior of the Yukon, where the snowfall the previous winter had been very light, yet I found conditions to be wholly different along the coast. Here the depth of snow was almost the heaviest on record, a large proportion having fallen late in March and during the early part of April.

I left Calgary on May 1, and reached Vancouver on May 5, having stopped over at Kamloops to purchase twenty pack horses. Having engaged the party and obtained the necessary outfit and supplies, I left Vancouver by the Canadian Pacific Railway company's steamer on May 14. Permission to land at Pyramid Harbour and to take the party up the Dalton trail through Alaska had been granted by the United States Government, and I wish to here acknowledge the uniform courtesy which we received from all United States officials, and indeed from every one with whom we came in contact while passing through Alaska.

The reasons for landing our outfit with horses at Pyramid Harbour were specified in detail in my report of last season. During the latter part of this season, however, a very good road has been constructed along the east side of Chilkat river from Haines to Wells, and the necessity of landing at Pyramid Harbour is now a thing of the past, as the best landing place is at Haines. At Wells a bridge is now under construction to connect this road with the new road, already finished, to Porcupine, and when the Klehini is bridged beyond Porcupine next summer, there will be no difficulty whatever in taking horses from Haines right up to Pleasant Camp, where Canadian territory is entered.

At Pyramid Harbour there were no regular facilities for landing, but through the courtesy of Mr. Walter Story, Superintendent of the Alaska Packers' Association, who had a steam launch and scow ready, we got everything on shore in an hour and a half after the arrival of the steamer, although we did not reach the harbour till near midnight.

From Pyramid Harbour the horses were taken up the old trail on the west side of Chilkat river and reached Wells, twenty-six miles farther up, after a two-days

journey, while the rest of the party crossed over to Hindistuckie and from there went up in canoes on the river, reaching Wells on May 21.

On coming up in the steamer from Vancouver, the low altitude of the snow on the mountains as we neared Pyramid Harbour did not appear to augur well for our journey up to the boundary, and on reaching Wells, the last hope of conditions being favourable was dispelled by the news that the snow had not yet left Porcupine which was thirteen miles farther on our journey and only eight hundred feet above sea-level,

It became necessary therefore, to remain a short time at Wells where there was a little feed for the horses in order to avoid as much as possible having to purchase hay and oats at the Porcupine rates which were one hundred and twenty dollars a ton. In the meantime the horses made several trips to Porcupine taking the heavy outfit and supplies ahead of the camp.

We moved camp to Porcupine on May 26, the snow being then nearly all gone except in a few shaded parts of the road, but the grass at Porcupine was still backward and the horses had to be kept at Wells as much as possible.

Porcupine practically consists of the works of the Porcupine Gold Mining company which are very extensive. There is a United States postoffice in this place and a good general store. It is the last settlement on the way up to the boundary except the mining camp at Rainy Hollow, B.C., which however, is about four miles off the regular trail.

On June 5 we moved on to Pleasant Camp although the snow was still deep on the road near Pleasant Camp, but I wished to get the outfit across the Klehini river, as it was slowly rising and is always a troublesome river to cross as soon as the heat of summer has started the flow from the glaciers.

The first load was sent by pack horses to Rainy Hollow by the lower trail on June 17, the horses returning by the upper trail on June 19 but they were so exhausted by the deep snow, both going and returning, that we had to wait another few days before camp could be moved to Rainy Hollow. This was done on June 22. The upper trail was still too blocked with snow for horses to take a load and the lower trail, which was used, was then in an extraordinary condition. That part of it which was through heavy spruce timber, amounting to about two-thirds of the whole distance, had still three feet of snow, while the remainder, being in partly open country with willows, was covered with two feet of liquid mud.

At Rainy Hollow at this date about half of the total area was bare of snow and the grass was coming up rapidly just as soon as the snow left each part, as it always does in that country. It is, in fact, astonishing what a change will occur in a few days when a midsummer sun is acting on a great depth of snow.

Rainy Hollow is ten miles from Pleasant Camp and at an altitude of 2,500 feet, being 1,500 feet higher than Pleasant Camp.

We made the first trip with a load to Glacier Camp on June 29, crossing the summit which is at an altitude of 3,800 feet. Glacier is eighteen miles from Rainy Hollow. There was no snow south of Clear creek except in the narrow valleys of three streams where the snow had to be shovelled out. North of Clear creek there were only patches of shallow snow and at Glacier Camp, at an elevation of 3,050 feet, everything was green, I think the snow had probably left there about June 15, the great depth of snow this spring having been confined to the southerly slope of the coast mountains. On this slope there was the heaviest snowfall and the latest spring since the year 1891.

Camp was moved to Glacier on July 1 and to Bear Camp on July 4. From Bear Camp a pack trail was cut northerly and then northeasterly up the Blanchard valley to the place where I had ended work last season.

As regards the relative advantages of reaching the locality where the boundary intersects the Dalton trail by the route here mentioned or by way of Skagway and Whitehorse, it may be said that the route by the Dalton trail is much shorter, but is not available for so long a season as the Whitehorse route.

Travelling by Haines the total distance to the boundary from the sea is about ninety-five miles. Freight is easily taken to Wells, at the head of navigation, and can be thus left within sixty-seven miles of the boundary at a cost of about one dollar and forty cents per hundred pounds. From Wells an outfit would have probably to do most of its own freighting although assistance might be obtained as far as Pleasant Camp to which there is a good wagon road.

By the Whitehorse route it is nearly two hundred and fifty miles from Skagway to the boundary, being one hundred miles by railway and then sixty-five miles by wagon road to Champagne Landing. From there it is seventy-five miles to Dalton Post and then thirteen miles farther to the boundary. There is, of course, no trouble getting freight to Whitehorse, and assistance in transportation could probably be obtained from there as far as Champagne Landing, but the cost from the sea to the Landing is very great, amounting in all to about seven dollars a hundred pounds, and in addition there is the railway fare at twenty dollars for each man and each horse.

A great deal would therefore depend on whether a long or short season is necessary. If the advantages of a longer season outweigh the extra cost by Whitehorse, as they will often do, then this route is the better of the two, while for any undertaking which requires only a short season it would appear to be the better plan to wait until the Haines route is free from snow. For such an undertaking I think the best time to land at Haines would be at such a date that the summit of the Dalton trail between Rainy Hollow and Glacier Camp would be crossed about June 25. It is the condition of this summit which determines the length of season when travelling by this route.

The limiting date up to which the Dalton trail is available for horses at the end of the season varies considerably. In 1907 we crossed the Glacier summit on October 1. The trail had been bare of snow up to the previous day, but on that date snow was falling and on October 8, there was a depth of three feet. This season we crossed the summit on September 24, and there was a depth of ten inches of snow everywhere with drifts up to three feet in all the depressions. I should suppose it to have been blocked for the season about three days after we crossed. This last season was considered a very bad one all through, but on one occasion at least this summit was impassable for horses as early as September 19. The difficulty of all travelling with horses in that country arises from the impossibility of waiting for a day if bad weather should come on. Once the snow commences to fall, it may keep piling up day and night and it becomes a case of travelling in difficulties to-day or incurring far greater difficulties to-morrow. As the end of a season draws on it is not at all a pleasant thought to know that certain summits must be crossed on the way out, more especially as these summits are often far in the rear, and it is not known what is occurring on them, whether they are free of snow or daily becoming more blocked up.

June 25 to September 22 are about the limiting dates between which it is fairly certain horses can cross Glacier summit, although in many seasons this may be extended to a period from June 20 to October 5.

The Whitehorse route, as a rule, opens two or three weeks earlier and closes about ten days later than the corresponding dates for the Dalton trail. The condition of the summit between Dalton Post and lake Dezadeash is what decides the length of the season. The route has, of course, the great advantage of being entirely in Canadian territory except for a part of the railway journey, over which a survey outfit can be bonded, which is an impossibility by the Haines route.

After reaching the boundary on July 7, it became necessary to get a camp established without delay as far up the Blanchard valley as possible in order that an observation for latitude might be obtained while the trial line, begun last season, was being continued east. The zenith telescope outfit was therefore taken up this valley to a point about ten and a half miles due east of Station "M" on Tatshenshini river. Here Mr. Blanchard Dodge took up his quarters and proceeded to make arrangements for an observation while the rest of the party returned to the main camp.

Work was commenced on the trial line on July 10, and it was surveyed up to the new observation station on July 18. Meanwhile on the nights of July 11, 12, 14 and 16, Mr. Dodge had obtained a very good latitude observation with the zenith telescope, the probable error of the mean of fifty observations on twenty-two pairs of stars being ± 0.06 of a second. In accordance with this a point was established on the sixtieth parallel and marked, as usual, by an iron and a wooden post with a stone cairn. This monument is marked "R."

While some of the monuments were being erected on the boundary west of "R," it was necessary to investigate the country to the east in order to find a suitable place for the next latitude observation. East of here the boundary leaves the Blanchard valley and a route had to be found by which horses could travel easterly. On July 20, I found that there was fortunately a very good pass about five miles east of "R," and a mile south of the boundary, leading over into the valley of a large river flowing northeasterly. While this pass was a good one so far as easy grade and freedom from rocks could make it fit for horses, yet on account of its altitude, which was 5,000 feet, it did not form a very attractive feature to have in our rear. It had become evident by this time that the season would be an unusually cold one and there was a considerable chance of this pass becoming blocked with snow early. In fact, at this date some of last winters ice still remained on a small lake at the summit.

From the summit, there was a descent of two thousand three hundred feet in about four miles, to the large river referred to which proved to be the river shown on the maps flowing into Kusawa lake. Its position on the map is, however, about nine miles too far east, and its topography is shown about seven miles too far north. It has been named Kusawa river.

The zenith telescope outfit was taken to the valley of this river on July 24, and a place selected on the banks of a small stream flowing northeasterly as the most suitable place for a latitude observation. This point is called station "S" and is a little over eight and a half miles east of "R." Mr. Dodge remained here to take the latitude observation and as the weather looked as though it intended to keep cloudy for some time, I decided not only to survey the trial line east from the last observation station as far as possible without moving from the Blanchard valley, but also to go back westerly and establish the boundary monuments between stations "M" and "R."

This arrangement was carried out, all the monuments being established by August 7 and camp was then moved easterly from near monument "M" up the Blanchard valley across the pass previously mentioned and down to Kusawa river where we arrived on August 11. The latitude observation at "S" had been completed some time previously and again resulted very well, the probable error of the mean of forty-one observations on eighteen pairs of stars being ± 0.05 of a second. Two days later the trial line was surveyed up to this new station.

East of Kusawa river it could be seen that the mountains became very much more rugged and lofty than any we had yet crossed and the prospects of getting the zenith telescope farther east looked very doubtful.

On August 20 I went easterly from Station "S" and ascended a high mountain about six miles away which it was evident, for a long time previously, the boundary line would have to cross. From the summit of this mountain, named Mt. Nevin, and which proved to be at an altitude of 7,259 feet, an extensive view was obtained. To the east there was a sudden descent of very nearly five thousand feet in a little over two miles to the valley of a stream flowing northwesterly to Kusawa river. East of this stream the mountains rose like a wall for about two thousand five hundred feet and then formed a confused mass of peaks and glaciers reaching about 7,000 feet. The general position of the valley of Takhini river could be clearly seen about ten miles farther east and as this was the westerly end of that part of the boundary which had been already surveyed, it was necessary to consider if the remaining gap could be completed.

There were two courses. One was to get the zenith telescope up the valley east of Mt. Nevin (it certainly could not be got any farther) and obtain a latitude observation there. This would ensure the survey of the boundary at least as far as this valley, but the delay of taking a new observation would almost certainly leave little chance for completing the line to Takhini river. The other course was to omit this observation altogether and with the time saved endeavour to establish the boundary right through between the monuments on Kusawa and Takhini rivers.

A new observation would involve great delay, not only on account of the bad weather, but because it would necessitate a pack trail being cut out for twelve miles in dense timber which meant taking the whole party ahead and then back again to survey the trial line. On the other hand, if this observation were omitted in an endeavour to complete the whole gap, it might not prove possible to survey a connection across the very rugged mountains to Takhini valley sufficiently precise to warrant its being used to establish the boundary, and this would mean that no part of the line at all would be established east of Kusawa river.

It was, in fact, a case of risking a fairly certain part for a very uncertain whole.

On August 25 when the trial line was surveyed up to the summit of Mt. Nevin and it was seen that a deflection of at least eight degrees to the north would be necessary to continue the line to Takhini valley the risk of trying to establish the whole boundary with such a deflected line as a basis seemed greater than ever. The accuracy of the measurements would be much more important than in the case of a due east line where an error of some extent may occur in distances without appreciably affecting the latitude of the stations. In such a rough area it would be impossible to make sufficiently precise measurements in the short time available even though only an accurate connection, and not a boundary line, were to be surveyed over the last miles to Takhini river, and it was finally decided to make sure of the part and only approximately connect the remainder of the gap.

A pack trail having been cut out for about six miles down Kusawa valley and then for another five miles up the valley of the stream previously referred to, which is called Hendon river, the zenith telescope was set up and arrangements completed for taking an observation on September 1. The trial line was surveyed up to the same point on September 7, a complex triangulation having to be made to get the line down into the depths of the valley.

While waiting for the weather to clear for the latitude observation it was decided to try to make a connection between this point, called station 'T,' and station 'L' on Takhini river. A week's supplies and a small quantity of firewood had been already packed by the men themselves into a kind of rocky valley which formed the end of a glacier and which ran back easterly from the top of the precipitous ascent on the east side of Hendon river, and which was 2,600 feet above the river. The ascent was made between the boundary and the stream flowing down from the glacier about half a mile north of the boundary. On September 8, Mr. Near, myself and five of the party took a small outfit up the mountain and camped for the night.

Next day we packed our outfit easterly about a mile and a half and ascended to the summit of a narrow ridge at an altitude of 6,200 feet which forms the west boundary of the Takhini watershed. There was a steep snowfield down the easterly slope of this ridge with a descent of about eighteen hundred feet into an open bare valley through which a stream flowed easterly to Takhini river. The day was the first fine one we had had for ten days, but it was not without some misgivings as to how we would fare on the return trip that the descent was made into this valley. The same afternoon the traverse was continued to a point about five and a half miles east of station 'T' and we camped at the upper limit of timber, about seventeen hundred feet above Takhini river, and about two miles north of the boundary. That night the weather returned to its former condition and snow fell at our camp at an altitude of 3,600 feet.

Next day while the triangulation was being continued, monument 'L' on the Takhini river was found. The river was easily forded on foot and an old pack trail was found on its east bank. The river does not flow nearly so swiftly as the Tatshenshini or the Kusawa, nor is it nearly so large a stream. It should be easily forded by horses if a place is chosen free of quicksand. The valley is a large one with much timber. Below the boundary two streams join the river on its west side, one on which we had our camp and another, a larger one, nearer the boundary. This last stream comes down from a valley which after the first steep rise from the Takhini appears to open out considerably as it passes to the west of a local high mountain immediately west of Takhini river. West of this valley I think the boundary would cross a round-topped mountain about 6,600 feet high whose surface is a mass of huge boulders and practically unclimable when the spaces between are filled with snow. The cause of such a condition is not very clear. We encountered many such mountains this season. Between this mountain and Hendon river there is an area of jagged peaks and irregular valleys all more or less filled with glaciers, the course of whose drainage is not very certain.

The connection made between stations 'T' and 'L' substantially follows the route described as taken by ourselves. I had intended to measure out a base line in Takhini valley and check the connection by closing on it, but the weather had been so bad that it became too risky to delay our return. The summit, three miles to the east of our camp, had been almost continually obscured in what looked like fog, but which we knew to mean a steadily increasing depth of snow. On September 12, with ten inches of snow freshly fallen at our camp, we started back and on reaching the snowfield at the summit found a fresh depth of nearly three feet of soft snow, which was steadily increasing. In a driving wind which obscured objects one hundred feet away we climbed up the snowfield and were not sorry to get back to the main camp.

According to this traverse the distance in an east and west direction between stations 'T' and 'L' is almost nine miles.

On our return it was found that a satisfactory observation for latitude had been obtained, the probable error of the mean of eighteen observations on seventeen pairs of stars being $\pm$ 0·10 of a second. It still remained to put in nearly all the boundary posts between there and the Blanchard valley.

The mounments as far as Kusawa river were completed on September 17. On the same day the head packer returned from Porcupine whither he had been sent ten days previously to distribute hay along the Dalton trail for our journey out. He brought back very bad reports of both Glacier and Parton summits, and we had not much time to lose. We crossed the Blanchard next day and having completed the work there started homewards on September 21. We reached Porcupine on September 25 only seeing the last of the snow on the road near Pleasant Camp at an elevation of 900 feet. Last season the snow line was about 3,500 feet on October 1.

Skagway was reached on September 30 and we left for Vancouver on October 2, having taken fifteen of the horses on board directly from Haines. We arrived at Vancouver on October 6 and I reached Calgary on the 10th, having made arrangements to winter the horses at Kamloops.

The most important valleys along the part of the boundary surveyed this season are those of Tatshenshini, Blanchard and Kusawa rivers. The eastern section is much more rugged than the western and it is a rule that the country is much rougher on the British Columbia than on the Yukon side.

While this is actually the case, the contrast is considerably increased by the fact that a person on the boundary when looking towards British Columbia sees only the northerly slopes of the mountains which are filled with snow, while when he looks to the north, he sees only the sides which have been exposed to the sun and he unconsciously concludes that there is no snow there.

From Tatshenshini river to Hendon river there are in all thirty-two monuments indicating the boundary.

Monument 'M' is situated in a dense growth of spruce and is on the east side of Tatshenshini river at an altitude of 2,528 feet, being four hundred and ten feet from the water's edge. From here there is a steep ascent up a bluff forming the west side of Tatshenshini valley, after which the boundary crosses a rough spruce covered plateau for a little over a quarter of a mile, when the land falls abruptly to the valley of Blanchard river, the distance of the two rivers apart being about seven-eights of a mile.

Blanchard river is seventy-seven feet wide where the boundary crosses it. It comes down from a source about twenty miles to the east and flowing around the southerly end of the high mountain range which follows up the east bank of Tatshenshini river from Dalton Post, it turns through a right angle and crosses the boundary flowing nearly due north, joining Tatshenshini river about two miles farther on. After crossing Blanchard river the boundary runs through an area of spruce timber, the ground rising steadily for about a mile and a half till it reaches the foot of the steep ascent of the mountain range just referred to. There are five boundary monuments in all between Tatshenshini river and the summit of this mountain. The sixth is on the summit at an elevation of 5,658 feet. From here there is a descent of 1,326 feet to a monument standing on the top of the easterly bank of a small stream flowing southerly after which there is a rise for nearly a mile to the next monument at an altitude of 5,090 feet. The boundary now passes obliquely down the side of the hills forming the north side of Blanchard valley, the last four miles before reaching 'R' being almost at the bottom of the valley. Along this northern slope and in the valley there are seven monuments, there being fourteen in all in the ten and a half miles between 'R' and 'M.' These monuments consist of an iron post driven flush with the ground, defining the boundary. The position of the iron post is shown by a wooden post planted beside it and standing as a rule about four and one-half feet out of the ground and surrounded by a circular cairn of stones about seven feet in diameter and four feet high. The posts are numbered in sections, the number on the post being preceded by the letter which indicates the monument where the nearest latitude observation was taken to the east and succeeded by the letter which indicates the monument where the next observation for latitude was taken to the west, the lettering and numbering being read from the top of the post downwards. The first monument west of monument 'R' is marked 'R.1.M' and the next one to the west is marked 'R.2.M,' and so on, the numbering of the posts being from the east towards the west in all cases.

The upper part of Blanchard valley, that is to say, the four miles westerly from 'R,' is about three-quarters of a mile wide and bare of timber along the river, although there are a few groves of spruce on both sides of the valley higher up its sides. There is a good pack trail along the north bank of the river which is kept well worn by the bears, this valley being apparently the original home of the brown bear. In this upper valley the current is not very swift but there are so many boulders that care has to be exercised in fording it with horses. Where it flows around the mountain range previously mentioned the river follows a tortuous course in a narrow deep valley thickly timbered and cannot as a rule be forded, although we found a fairly good ford for the horses a little above a well marked cut-bank which occurs on the south side of the river about half a mile below where the river enters the heavy timber. The river can generally be forded on foot lower down where it crosses the boundary. The mountains on the north side of Blanchard valley are generally round-topped. Those south of the valley are much higher and more rugged.

East of 'R' the line crosses a moderate ascent as it leaves the valley of the Blanchard and at an altitude of 4,600 feet a wide rough kind of plateau covered with turf is reached extending easterly for about two and a half miles. There is one boundary monument about three-quarters way up the first ascent from 'R' and four monuments are placed on the plateau. At the east of the plateau a wide rocky valley turns off to the southeast leading up to the pass while the boundary line crosses the southerly

shoulder of a local range forming the northeasterly side of the pass. There is no monument on this shoulder, but one stands in the pass about half a mile before its summit and would be reached by a person travelling easterly. From the top of this mountain there is a steady descent to Kusawa river, the boundary being defined by two monuments before 'S' is reached.

The monuments in this section are numbered 'S. 1 R.,' 'S. 2 R.,' &c., from east to west.

Kusawa river is a large stream, considerably larger than Tatshenshini at station 'M.' It is a bad river for horses to cross, there being a large number of boulders whose position cannot be seen owing to the glacial drift in the water. We forded it just below an island and about three-quarters of a mile north of the boundary. In the latter part of August it was about as deep as a horse could ford. The river apparently rises a long way to the south and comes down through a wide valley much broken by small hills and rocky bluffs leading up to the steep slopes of the mountains on either side. North of the boundary the valley is not so rough and is thickly timbered with spruce and jackpine with scattered poplar. Winds blow with terrific violence nearly every day in this neighbourhood. The elevation of the river where it crosses the boundary is 2,591 feet. There is a monument on its west bank.

East of the Kusawa river there is a steep rocky bluff seven hundred feet high and then the boundary crosses a rough country for three-quarters of a mile to the foot of a sharp high range sloping steeply to the north. Two monuments indicate the boundary between Kusawa river and the foot of the range. The altitude of the crossing of the range is 5,789 feet. From there a precipitous descent of nearly two thousand feet occurs into an open valley in which a small stream flows northwesterly to Kusawa river. The crossing of this valley is at an elevation of 3,866 feet, well above timber limit. There is good feed for horses in the valley which extends about a mile and a half north of the boundary after which there is a steep descent through timber to Kusawa river. The stream rises in a very large area of glaciers about four miles south of the boundary. A monument stands in the valley about four hundred and seventy feet west of the stream.

There is a local precipice twelve hundred feet high on the east side of this valley where the boundary crosses it, a monument being placed about three hundred feet east of its summit. There is then a long steady rise of another two thousand three hundred feet to the summit of Mt. Nevin, where the altitude is 7,259 feet, the monument on its summit being the highest point on the boundary between Tatshenshini and Takhini rivers. A large section of the mountain appears to have broken away at some former period and to have fallen into the valley below, there being a huge semicircular cavity along its northeasterly face which is occupied by a snowfield. From the summit of this mountain there is a fall of four thousand eight hundred and sixty feet into the valley of Hendon river in which stands monument 'T' at an elevation of 2,407 feet. The boundary posts in this last section are marked 'T. 1 S.,' 'T. 2 S.,' &c., from east to west.

Hendon river has a slow current. It rises in a glacier about two miles south of the boundary and follows a fairly straight course between lofty and precipitous mountains on both sides for a further distance of about seven miles, to its junction with Kusawa river. There are several lakes in the valley formed by rock slides having blocked up the course of the river. Timber extends along the banks of the river up to the boundary, but it is generally of small size.

The general elevation of the upper limit of spruce between Tatshenshini and Takhini rivers is about 3,300 feet although isolated trees may occasionally be found up to 3,600 feet. Poplar is rare and keeps well below the limit of spruce.

Except the timber encountered in Blanchard valley near Tatshenshini river and that on the east bank of Kusawa river, the boundary line does not actually intersect any timber in the whole thirty-six miles from Tatshenshini to Takhini valley.

The season along this section of the boundary and farther south was a very cold and short one, beginning later and closing earlier than last season. Although the average elevation of camp was only 3,300 feet the temperature fell below freezing point on thirty-six nights between July 1 and September 23. The mean temperature in the shade at two o'clock on the afternoon was 59° in July, 54° in August and 47° in September, the mean minima at night for these three months being 34°, 39° and 29°. Though we had not much rain yet the sky was generally densely clouded and the low average temperature resulted in snow frequently falling when it would have only rained in most seasons.

The immediate cause of the cloudiness during the season was the prevalence of a south wind from the coast. As we were about on the summit of the high land and moreover had a vast area of glaciers a few miles south of us, we had fogs and clouds while the interior of the Yukon had a very fine summer. A northerly wind during the summer always brought fine weather.

In concluding this report it is hardly necessary for me to point out the great value of the assistance given by Mr. Blanchard Dodge. His work this season more than confirmed the high opinion I formed of his abilities during last season.

Mr. Percy Near, the second assistant, also rendered great aid in the transit work and in the details of camp life.

The other members of the party showed more than usual interest in their work and especially was such the case in the conduct of those who were engaged on the severe trip when making the connection between Hendon and Takhini rivers. Not a few men would have refused to remain so long in such a risky situation.

I have the honour to be, sir,
Your obedient servant,

J. N. WALLACE, D.L.S.

SURVEY OF PART OF YUKON-BRITISH COLUMBIA BOUNDARY.

TEMPERATURES DURING SEASON 1908-09.

Date.	lace.	Altitude.	7 A.M.	2 P.M.	8 P.M.	Minimum at Night.	Weather.
June 1	Porcupine, Alaska	800	48	60	50	25	Fine.
" 2	"	800	49	67	50	33	"
" 3	"	800	54	70	53	31	Fair.
" 4	"	800	54	64	52	36	"
" 5	Pleasant Camp. B.C.	1000	56	66	50	40	Fine.
" 6	"	1000	48	52	48	40	Rain.
" 7	"	1000	50	66	46	33	"
" 8	"	1000	52	62	47	25	Fine.
" 9	"	1000	49	64	46	32	"
" 10	"	1000	58	69	51	39	"
" 11	"	1000	60	66	50	40	"
" 12	"	1000	58	64	50	42	Fair.
" 13	"	1000	50	62	49	40	Rain.
" 14	"	1000	52	60	49	37	Fine.
" 15	"	1000	58	64	54	39	"
" 16	"	1000	57	68	50	42	"
" 17	"	1000	58	62	..	37	"
" 18	"	1000	60	67	52	35	"
" 19	"	1000	56	72	57	37	"
" 20	"	1000	54	71	58	42	"
" 21	"	1000	58	71	58	42	"
" 22	Rainy Hollow, B.C.	2500	51	65	60	43	Fair.
" 23	"	2500	49	73	57	48	Rain.
" 24	"	2500	53	66	56	45	Fair.
" 25	"	2500	57	68	48	42	"
" 26	"	2500	48	55	47	42	Overcast.
" 27	"	2500	45	60	50	40	"
" 28	"	2500	50	62	51	30	"
" 29	"	2500	50	52	47	43	Rain.
" 30	Glacier Camp, B.C.	3050	47	62	53	43	"
July 1	"	3050	53	55	50	43	Fair.
" 2	"	3050	54	57	47	41	"
" 3	"	3050	47	58	49	35	Fine.
" 4	Bear Camp, B.C.	3050	51	60	50	37	"
" 5	"	3050	52	55	46	37	Overcast.
" 6	"	3050	46	50	42	30	"
" 7	Blanchard Valley	3250	43	55	42	31	Fine.
" 8	"	3250	47	59	45	38	"
" 9	"	3250	45	58	44	32	Overcast.
" 10	"	3600	46	56	44	30	"
" 11	"	3600	50	57	56	24	"
" 12	"	3600	52	66	58	37	Fine.
" 13	"	3600	56	74	59	37	"
" 14	"	3600	60	80	60	30	"
" 15	"	3600	51	70	54	42	"
" 16	"	3600	57	70	50	30	"
" 17	"	3450	51	60	53	45	"
" 18	"	3450	48	50	40	36	Overcast.
" 19	"	3450	45	47	45	31	"
" 20	"	3450	45	56	44	26	"
" 21	"	3450	54	58	46	42	"
" 22	"	3450	44	59	40	35	Fair.
" 23	"	3450	42	56	44	35	Rain.
" 24	"	3450	41	54	44	30	"
" 25	"	3450	43	52	45	29	Fair.
" 26	"	3450	45	56	50	40	Rain.
" 27	"	3450	48	54	51	35	Fair.
" 28	"	3150	52	62	50	31	Fine.
" 29	"	3150	45	60	50	40	"
" 30	"	3150	47	54	51	29	Fair.
" 31	"	3150	47	62	50	36	Fine.
Aug. 1	"	2600	44	51	45	39	Rain.
" 2	"	2600	42	51	44	40	Fair.

SESSIONAL PAPER No. 25b

SURVEY OF PART OF YUKON-BRITISH COLUMBIA BOUNDARY—*Con.*

TEMPERATURES DURING SEASON 1908-09—*Continued.*

Date.	Place.	Altitude.	7 A.M.	2 P.M.	8 P.M.	Minimum at Night.	Weather.
August 3	Blanchard Valley	2600	46	56	48	41	Rain.
" 4	"	2600	49	65	49	28	Fine.
" 5	"	2600	48	62	48	25	"
" 6	"	2600	51	52	47	42	Overcast.
" 7	"	2600	47	58	50	42	"
" 8	"	3450	50	56	46	35	Fine.
" 9	"	3450	50	59	45	26	Overcast.
" 10	Near Pass	4500	36	62	42	30	Fair.
" 11	Kusawa Valley	2700	42	63	54	43	Fine.
" 12	"	2700	57	66	56	42	"
" 13	"	2700	56	53	50	46	Overcast.
" 14	"	2700	50	56	46	37	Fair.
" 15	"	2700	44	56	45	43	Overcast.
" 16	"	2700	46	57	44	42	"
" 17	"	2700	44	54	47	46	Rain.
" 18	"	2700	52	56	48	43	Overcast.
" 19	"	2700	46	60	47	29	Fine.
" 20	"	2700	45	57	50	42	Fair.
" 21	"	2600	46	52	50	40	"
" 22	"	3700	47	50	47	40	"
" 23	"	3700	45	50	45	39	"
" 24	"	3700	42	56	46	34	"
" 25	"	3700	42	50	45	40	Fair.
" 26	Hendon River	2100	45	59	54	41	Overcast.
" 27	"	2100	46	65	56	48	"
" 28	"	2100	50	58	46	38	Rain.
" 29	"	2100	51	54	50	44	Fine.
" 30	"	2100	48	57	55	46	Overcast.
" 31	"	2100	51	56	51	44	Rain.
September 1	Hendon Valley	2400	49	50	47	43	Overcast.
" 2	Hendon River	2400	44	49	47	44	"
" 3	"	2400	46	51	47	44	"
" 4	"	2400	44	48	46	38	"
" 5	"	2400	43	45	38	32	"
" 6	"	2400	44	42	36	29	Snow.
" 7	"	2400	33	40	37	26	Overcast.
" 8	"	2400	34	45	38	24	"
" 9	"	2400	34	52	32	30	Fine.
" 10	"	2400	34	44	38	35	Rain.
" 11	"	2400	36	46	40	32	"
" 12	"	2400	34	40	39	33	"
" 13	"	2400	36	42	38	34	Snow.
" 14	Kusawa Valley	3700	38	40	31	22	Fine.
" 15	"	3700	30	39	37	29	"
" 16	"	3700	34	38	37	36	Snow.
" 17	"	2600	41	46	40	39	Rain.
" 18	Blanchard Valley	3450	44	48	34	28	Fine.
" 19	"	3450	33	39	34	20	Snow.
" 20	"	3450	33	46	27	26	"
" 21	"	3450	28	..	26	28	"
" 22	Bear Camp	3050	26	..	27	16	Fine.
" 23	Glacier Camp	3050	29	39	31	30	"
" 24	Rainy Hollow	2500	30	36	37	30	Snow.
" 25	Porcupine, Alaska	800	30	..	33	30	Fine.
" 26	Wells, Alaska	300	32	..	33	32	"
" 27	"	300	33	39	35	30	Snow.

APPENDIX No. 47.

REPORT OF JAS. WARREN, D.L.S.

MISCELLANEOUS RESURVEYS IN SOUTHERN SASKATCHEWAN.

WALKERTON, Ont., February 20, 1909.

E. DEVILLE, ESQ., LL.D.
Surveyor General,
Ottawa.

SIR,—I have the honour, in accordance with my instructions dated April 18, 1906. to submit the following general report on my survey operations during the season of 1906.

I left home about the end of May and proceeded to Moosejaw where I was to get my outfit together. After having the horses brought in from their winter quarters I decided to move to Maple Creek station by train as there was so much rain that the roads and trails would be very heavy to travel. On our arrival there we were delayed several days on account of rain. After getting camped I proceeded with the resurvey of township 22, range 28, west of the third meridian.

I next completed the resurvey of township 21, range 28 and townships 21 and 22, range 27, and then retraced townships 11 and 12, ranges 25 and 26 that were allotted to me in the season of 1905, but had not been completed. I began the work in these townships on July 25 and completed it on September 5. From here I moved to township 14, range 30, west of the second meridian to make a retracement survey. Having completed this fractional township I moved east to township 14, range 19 to subdivide into quarter sections the beds of two dried up lakes. I found the lakes all dry except a portion of sections 10 and 15.

From this township I proceeded to township 16, range 15 to rectify a discrepancy in the subdivision of that township. I found on my arrival there that some of the owners of the land would not consent to any change. They had signed a petition stating that they wanted a resurvey made but they declared that their names were got by misrepresentation. I therefore had to abandon the work there, and proceeded to township 19, range 24 to make some resurveys, which were completed about October 9.

On completing this work I made arrangements for wintering the horses and storing the outfit, and left for home.

I have the honour to be, sir,
Your obedient servant,

JAMES WARREN, D.L.S.

APPENDIX No. 48.

REPORT OF JAS. WARREN, D.L.S.

SUBDIVISION IN SOUTHERN ALBERTA.

WALKERTON, Ont., February 18, 1909.

E. DEVILLE, ESQ., LL.D.,
Surveyor General,
Ottawa.

SIR,—I have the honour in accordance with my instructions, dated April 23, 1908, to submit the following report on my surveying operations during the past season.

I left home on May 6 for Calgary where I was to collect my outfit. The weather was so very wet that it delayed operations in getting the camp and transport outfit under way. I found the horses in good order, having been well wintered, and they accordingly stood the season's work very well. After some delay we left Calgary on May 18 to commence work on part of township 22, range 5, west of the fifth meridian. We arrived at this township on the 20th. The trail was very wet and we could make but slow progress, yet we got through without any serious mishaps, except a few unpleasant adventures in sloughs and muskegs, just enough to get us used to what was coming.

We had no trouble in locating our work as some of the adjoining work had been done recently and we had no trouble to connect our work with what had been previously done. The weather was very wet for about three weeks, so much so that we were not able to work more than two or three days in the week. We completed the part of this township required, but as Elbow river was so deep and rapid owing to the incessant rains we continued work for a few days longer so as to allow the flood to subside. As soon as the river was safe to ford we crossed into township 23 range 5 just north of where we were working and completed the subdivision of that part of the township allotted without any material difficulty. After completing this township we made arrangements to traverse Willow creek in township 14 range 1. Owing to the floods, many of the bridges were carried away and the rivers difficult to cross, so we had to go around by Calgary. We left Calgary on June 29 and reached Willow creek in good time, after a few mishaps and breakdowns on the way. We completed the traverse of the creek on July 16 and at once moved camp into township 13, range 2, arriving there on July 17.

Our first work was to run the north boundaries of sections 33, 32 and 31, which we did by producing the already established boundary of sections 34, 35 and 36. After completing this outline we proceeded to the southwest corner of the township where we took an observation, and ran due north to meet the north boundary already run, but on arriving at the corner we were over four chains too far east. We suspected that the measurement of the base line must be out, so we chained easterly from the southwest corner of the township along the line already run. After chaining one mile after another we found discrepancies that in four and one-half miles amounted to over four chains.

I then telegraphed to the Department stating the above facts and asking for instructions. In reply I was directed to resurvey the base line across range 2, making all quarter sections 40·37 chains so as to make up the shortage in range 2, and also a

shortage in range 1. On arriving at the southwest corner we took another observation and ran due north making all quarter sections forty chains, this chainage went past the line already run at the north boundary of section 3, and also to the west. This chainage necessitated the resurvey of the north boundaries of sections 31, 32 and 33, which was done. After establishing the east boundary of township 13, range 3, we subdivided all the available land for settlement in the remainder of the township. I may say that there were a great many squatters on the available land, who hope to make for themselves good comfortable homes on the land chosen. I may state here that owing to a difference found in the bearing of the base line in range 2, we had to recut the whole distance of six miles, which difference affected range 3 as well, as the lines did not meet at the southwest corner.

As I had to produce the base line across range 3, I ran three miles westerly from the southwest corner of the township but as the mountains were so high and no pass by which we could cross I had to go south and enter the Livingstone by 'the gap' and went north to the north boundary of township 12 from which we connected with the line already run for three miles; I then produced it across sections 33, 32 and 31, making all these quarter sections forty chains. On completing the base line in range 3, I produced it across range 4, having first taken an observation at the northeast corner of township 12, range 4.

From the northeast corner of township 12, I ran the eastern boundary of that township to the southeast corner of the same. I then ran two miles westerly along the north boundary of township 11, range 4, also one mile easterly along the north boundary of township 11, range 3. From this corner I ran south along the east boundaries of sections 31, 30, 19, 18, 7 and 6. I also ran the north boundary of section 7 in this township and the north boundary of sections 11 and 12 in township 11, range 4, in order to locate the north boundary of the west half of section 11. From the southeast corner of section 6 in township 11, range 3 I ran a traverse line into township 10, range 4, in order to locate the east boundary of section 22 in that township, which completed the work in the Livingstone valley.

We now moved out to Cowley with our outfit on December 29 and disbanded the party on December 31. In the meantime I had arranged for the wintering of the horses and the storing of the outfit.

After completing these arrangements I went to Calgary, and from there went on to Reed lake in townships 16 and 17, ranges 8 and 9, west of the third meridian. I found the ground too frozen to attempt doing any work there, and on advice from the Department I abandoned any further work and arranged to return home, where I arrived on January 9, 1909. Some of the country surveyed is well fitted for ranching purposes there being good feed and plenty of hay in many places. The water is beautiful, there being many fine streams from the mountains of the purest and best of water, which abound with speckled and rainbow trout of the finest quality.

I have the honour to be, sir,
Your obedient servant,

JAMES WARREN, D.L.S.

APPENDIX No. 49.

REPORT OF A. O. WHEELER, D.L.S.

EXAMINATION OF LANDS IN THE RAILWAY BELT, B.C.

OFFICE OF TOPOGRAPHER,
CALGARY, ALBERTA, February 27, 1909.

E. DEVILLE, Esq., LL.D.,
Surveyor General,
Ottawa.

SIR,—I beg to submit, herewith, my report dealing with the classification of undisposed of lands within the railway belt in the province of British Columbia. The survey was for the purpose of ascertaining what parts of the said undisposed of lands would come under the following heads, viz.: fruit lands, grazing lands, timber lands and worthless lands.

In accordance with your instructions, three parties were placed in the field, one, in charge of M. P. Bridgland, D.L.S., worked in the Columbia valley, north and south of Golden; one, in charge of H. G. Wheeler, worked in the Columbia valley, north and south of Revelstoke, and the third, in my own charge, worked in the vicinity of Shuswap lake. Reports from the gentlemen in charge of the Golden and Revelstoke parties are submitted herewith. They give details of their operations and the results obtained.

Having organized and started the parties at Golden and Revelstoke, I proceeded with my own party to Sicamous, where horses and camp outfit had already been sent. It was found that horses could not be used around the lake, owing to the rough and rocky shores, so they were transported to Canoe point and left where there was convenient pasturage. Boats at Sicamous are difficult to obtain, but arrangements were made to rent a small one from the lessee of the Canadian Pacific Railway hotel at the place. In addition, the party had a small acme canvas canoe. This transport was wholly inadequate for the long distance that it was necessary to traverse over the several arms of Shuswap lake, and had it not been that I was fortunate enough to render a service to the Sovereign Lumber company, operating at the head of Anstey arm, through locating some of their timber boundaries and who, in return, placed their gasoline launch at my disposal for moving camp, at a charge for running expenses only, there would have been great difficulties with the transport of camp and supplies.

The period from July 21 to July 26 was spent looking over lands on Canoe point not far from Sicamous. Camp was then moved to the head of Anstey arm and work carried on there until August 9. From that date until August 31 the examination of lands was continued on both sides of Anstey arm. No township or section corners have been placed on the shores of the arm, so it was found necessary to make a triangulation to locate the areas of lands examined, and also a chain and compass traverse of the water fronts of such areas. The triangulation was tied on to the township section corners established by J. E. Ross, D.L.S., at Cinnemousun narrows.

During this period, I visited Golden and Revelstoke to ascertain how the gentlemen in charge at those points were progressing and to make further arrangements for their work.

On September 1, camp was moved to the narrows and work carried on in the vicinity until the 7th, when a move was made to the head of Seymour arm. This work engaged the party until October 8. Golden and Revelstoke were again visited in connection with operations in those localities.

From October 9, until November 25, lands adjoining the portion of Shuswap lake known as 'the long traverse,' extending westerly from the narrows to the main outlet, were examined, particularly in the localities of Blind bay, Notch hill, White lake, and Meadow, Manson and Ross creeks, joining the lake on the north shore of 'the long traverse.'

Winter is now setting in, and travelling by boat, owing to high winds, on the lake, became very uncertain. Moreover, the area surrounding the lake where undisposed of agricultural lands might be found to any appreciable extent had been examined, so the party was brought in and paid off. Owing to heavy snowfalls in the Golden district, and the work having been finished in the Revelstoke district, the other two parties had been paid off on the 16th and 17th of November.

In conducting the examinations the following methods and instruments have been employed:—When the lands examined were situated within surveyed territory the survey lines were traced and the sections traversed in a sufficient number of directions to enable an intelligent report to be prepared upon their classification. In unsurveyed territory, triangulations, traverses and approximate production of the township subdivision lines were made to locate the areas reported upon.

For triangulation work a three-inch Troughton and Simms transit-theodolite was used, and for traverses a four-inch surveying compass, a sixty-six foot chain and a stadia rod.

For the land examinations direction was obtained from prismatic and pocket compasses, and distance by the chain and by pacing with the assistance of a tally-register. Elevations above the respective levels of Shuswap lake and Columbia river in the several localities were computed by means of aneroid barometers carried by the examiners and checked for fluctuation of atmospheric pressure by stationery aneroids read at the camp every two hours throughout the day. Thermometer readings were taken at the same time as the readings of the stationery aneroids and maximum and minimum thermometers recorded the highest and lowest temperatures daily. During the months of October and November temperature readings of Shuswap lake were obtained. Tables of these readings are annexed.

DESCRIPTION OF LAND AROUND SHUSWAP LAKE.

For the purposes of agriculture, the climatic conditions of the Columbia valley render it of very special value, on account of its mildness and humidity. The vapour currents crossing the continent from the Pacific ocean, on reaching the high lands of the Gold and Selkirk ranges, rise, and, cooling rapidly, deposit their moisture along these watersheds. Then sweeping swiftly downwards into the valleys below they become heated, and a chinook effect is produced which creates a climatic condition particularly adapted to the successful cultivation of fruits, vegetables and fodder crops. Joined to this the humidity and mildness of temperature produced by the large body of water flowing and spread out in the form of lagoons in the Columbia valley, render it of special value for the purposes named. This is shown by the tropical luxuriance of growth of the natural flora and the abundance of small wild fruits that may be found.

The swift flowing river, fed by hundreds of silt-laden mountain torrents has, through its long course, carved a way from level to level, creating terraces of bench lands and piling up alluvial flats, now densely timbered. These flats and benches will, when cleared and made fit for cultivation, be very valuable replacing the great wealth that now stands upon them in the large tracts of magnificent merchantable timber with which they are still clothed in many localities.

The tropical growth of cedar, Douglas fir, spruce, hemlock and minor vegetation in the Columbia valley is more apparent above and below Revelstoke than above and below Golden, because the precipitation on the western slopes of the Selkirks is greater and the valley is at a lower altitude. This abundance of moisture in conjunction with the tropical heat of the sun, intensified in the deep trough of the valley, tends to produce the luxuriance of flora here found. The same effect, though not to so great a degree, is seen above and below Golden. The causes that have produced such a magnificent natural growth will be found equally beneficial in the interests of the settlers who are now making their homes in the valley.

Notwithstanding, it is doubtful whether cultivation on the benches can be brought to a high state of perfection without the artificial application of water, for the great heat in summer, so efficient in the maturing of growth, dries out the soil and counteracts its own influence. This condition is more clearly apparent in the Columbia valley near Golden. In the interests of irrigation to these bench and bottom lands, the action of the Department in setting aside as reserved large timbered areas along the watersheds of streams available for such purposes can readily be understood and appreciated.

In the Shuswap lake district conditions are different. The lake stretches out in a number of narrow arms lying in deep mountain troughs resembling fiords. As an almost invariable rule, there is a sharp ascent from the water's edge, which either continues directly up the mountain side for two or more thousand feet, or leads to a bench land or series of bench lands gradually merging with the steep slopes of the mountain. Flats that can be designated as bottom lands are few and are generally found at the mouths of the larger tributary streams where they have, through the course of ages, either filled in the ends of the arms or pushed deltas out into them.

The lake is practically divided into two parts by the Cinnemousun narrows which is less than half a mile wide. On the east side lie Anstey arm reaching northeasterly, the main body of the lake from the narrows to Sicamous and Salmon arm branching westerly from it at the southern end. On the west side are Seymour arm reaching farthest north and slightly beyond the limits of the railway belt, and then the main body of the lake, extending westerly from the narrows and known as 'the long traverse.' From its farthest extremity South Thompson river flows westerly to Little Shuswap lake and from there to Kamloops lake.

At the western end of Salmon arm, entered by the river of that name, a very minor stream, there are considerable areas of very excellent land well under cultivation and producing some fine orchards now bearing quite extensively a first class grade of fruit. Practically all the available land fit for cultivation on this arm is disposed of. At Sicamous two streams enter the lake, Eagle river from the summit of the Gold range, and Shuswap river, the outlet of Mara lake, one of a chain of lakes reaching southwesterly from Shuswap lake. There are still available agricultural lands lying in the valley of Eagle river but the choice parts are disposed of.

Except for a few hundred acres of doubtful utility on Canoe point, at the northeast corner of Salmon arm, there are no undisposed of agricultural lands between Sicamous and the narrows. On Canoe point there are several quarter sections for which entries have been given, where fruits large and small, are now being grown with varying success.

It is a peculiarity of this form of lake that where mountain torrents enter they form a small fan-shaped delta, containing as a rule, a few acres of land that can be cultivated, generally stony. On two of these on the Sicamous stretch, houses have been built and inhabited during the summer.

At the head of the Anstey arm there is a flat extending a short distance northward to Hunakwa lake, a small sheet of water at one time, without doubt, part of the arm. The best portion of the flat is included in a provincial grant of three hundred acres. The remainder is covered by timber berth No. 241. There are some

bench lands and high lands at the back and east side of the flat, but not of very large area. Most of the remaining possible lands on Anstey arm are bench and high lands, varying in altitude from 100 to 1,200 feet above the lake.

There are very few bottom lands on Seymour arm within the railway belt, perhaps 1,200 to 1,500 acres of good land in all, extending southward to Hunakwa lake, but a considerable portion of it is under timber license. This area slopes gently to Hunakwa lake, being elevated towards the Seymour arm end. There is a small flat at Celista creek, again under timber license, and for the rest, there are only bench lands and high lands, more or less difficult of approach on account of the steep ascent immediately adjoining the lake.

At Cinnemousun narrows a small area is found on both sides that could be cultivated if not too arid when cleared.

Along the south side of 'the long traverse', bench and high lands are found for about twelve miles. This area is rough and broken and only moderately well watered. It is of somewhat doubtful utility. At the west end of the tract, however, in sections 3, 4, 5 and 6 of township 23, range 9, is a patch of some hundreds of acres that can be cultivated to advantage and has no timber of merchantable value upon it. This will undoubtedly be settled as soon as surveyed, for there are already three squatters upon it.

Farther west, at Blind bay, on the slopes of Notch hill, in township 22, range 11 there is now a progressive settlement with almost every quarter section occupied between Shuswap lake and the Canadian Pacific railway, to the south. The settlement is now spreading easterly across White creek in township 22, range 10. There is some good land in the vicinity of White lake which was covered by valuable timber. Unfortunately, during the past summer, a considerable quantity of this timber was burned by forest fires, entailing a very heavy loss, not only of timber, but also of outlay to the lumber company leasing it. Intending settlers have now posted notices in prominent spots through the woods, stating that they have applied for entry on certain quarter sections. Most of the land has been surveyed, but the surveys do not extend to the eastern end of the lake where some suitable land may be found. West of the centre line of township 22, range 11, in the Blind bay settlement, all choice land is disposed of by entries that have been granted. During the past summer a number have been given east of the same line.

On the opposite side of the lake a new settlement has sprung up in the vicinity of Meadow, Manson and Ross creeks. Every available quarter section has been squatted upon, most of the settlers having wives and children. This tract of land has been surveyed in part and it is only where the surveys have not extended that it is unoccupied. There is a postoffice named Celista, and a school is in contemplation, which will be needed, for already four children have been born in the settlement. The Government has recently cut out a road through the settlement, although, I understand that at present only one squatter has received an entry; he has been on his land for fifteen years. The settlement is in townships 23, ranges 9 and 10. The reason no entries have been given is that the entire tract is covered by one of those large reserve areas within which lumber companies are given the right to select blocks of timber. The same restriction applies to Blind bay settlement. In the natural condition of things the land which grows the best timber is that most suited for cultivation and, consequently, there is bound to be a clash between the two interests, apparently the only practical remedy being the removal of the timber.

West of the centre line of township 22, range 11 on the south side, and of Celista settlement on the north side, with the possible exception of a few minor areas, the land available for agricultural purposes at this end of Shuswap lake is either covered by Indian reserves or has been disposed of.

At the head of Seymour arm, also, a settlement is beginning. Several quarter sections have been squatted upon and so far one entry has been given. One of these squatters brought in his wife and family during the fall.

These settlements have communication with the railway and sources of supply by means of gasoline launches which cover long distances with ease and speed. While every settler has his old fashioned boat, there are always one or more launches ready to supply his needs. There are also a number of steamboats plying on the lake in connection with lumber operations.

Camping at the narrows one notes with surprise the amount of travel to and fro in this wilderness of forest, rock and water, by incoming settlers, by lumber interests, by prospectors and by holiday trappers, sportsmen and artists, for the excellent fishing and delightful scenic beauties of the lake attract attention from many quarters.

It is a great pity that more land suitable for cultivation is not found surrounding Shuswap lake, for the climatic conditions are ideal. Not only does the extended lake surface act as a reflector to radiate heat rays, while disseminating moisture during the summer, but it retards the approach of winter, owing to the time the heated body of water takes to cool. During the past season maximum and minimum temperatures were taken daily of the atmosphere and of the lake during the months of October and November. On October 14, when the second reading of the lake was taken, at 7.15 a.m., the thermometer stood at 38° 30′ Fahr., while the temperature of the lake was 53° Fahr. On November 24, the last reading was taken at 8.50 a.m., the thermometer standing at 39° Fahr., when the temperature of the lake was 45° 30′ Fahr.

The effect produced by the heated vapour from the water surface rising into the the cold fall atmosphere is very interesting.

Every morning the trough of the lake is filled with a dense mass of cloud reaching down to about 1,200 or 1,500 feet above the surface. This represents the height at which condensation takes place and would suggest the altitude to which the lake influence would extend for the purposes of cultivation. In a few hours the sun breaks up this vapour zone and fills the valleys with most fantastic cloud-shapes, showing picturesquely against the forest-clad sides of the mountain spurs.

Readings of the aneroid barometer were also taken at the several camps every two hours for the purpose of ascertaining the barometric pressure of the atmosphere and of correcting the barometers used while at work, for fluctuation of such pressure.

The climate of the lake, moreover, is subject to local variations. I have known it to rain all day on Anstey or Seymour arm, while on 'the long traverse' the sun shone and no rain fell. In the same manner it would rain at Sicamous and be quite fine a few miles distant on Salmon arm. These diverse conditions are due to the varying narrowness of the several troughs of the lake and the direction in which they lie, furnishing greater or less facility for the sun to reach their depths and disperse the body of vapour filling them.

A map has been prepared and forwarded to the Department, showing by colours lands of three classes that have been examined and considered possible for cultivation.

A schedule also has been prepared and forwarded to the Department giving a short synopsis of the sections or quarter sections examined, stating in general terms the character, the altitude above the lake, the soil, the timber, and the quality as agricultural land.

The lands in the schedule refer only to those that may be considered as possibly available for agricultural purposes either wholly or in part. They seem to be subject to the question of whether there would be sufficient moisture when the timber is cleared off. With the exception of a few flats where the alluvial soil is spread more deeply and where the growth is luxuriant owing to collection of moisture (most frequently grown with large-sized cedar, devil's club and skunk cabbage) they are generally speaking very stony. While stony ground is not prohibitive to fruit growing, judging by what has been seen, it is very porous and would soon dry out if exposed without cover to the heat of the sun. The gauge for utility as agricultural lands has been the possibility of using a plough. The height above the lake for such lands is generally set at 500 feet but it has been carried, where possible, up to 1,200 feet.

It will be found that a large amount of land embraced, to the early settler looking for choice spots, is quite outside the pale. It is difficult to say what land may not be used in the future. In Switzerland, in the Rhone valley, I have seen every foot of space utilized for the growth of grapes and small fruits by building up retaining walls along the mountain side and spreading mould upon the little platforms thus created, many no wider than ten feet. Whole sides of mountains are thus utilized to produce crops that have a rich marketable value.

With the suitable climatic conditions of Shuswap lake, I should think the industry of small fruits could be successfully carried on in this manner, when it becomes necessary. At Celista settlement, I saw strawberries planted out on little terraces cut from a steep hillside. At Blind bay settlement, one of the settlers, Mr. J. Barnard, took me into his garden on November 6, and cut me several bunches of fine grapes from his vines in the open air. They were delicious. Both these and his peaches had taken prizes at the fruit exibit held at Salmon arm that summer. In the same garden, tomatoes, marrows and cucumbers were lying about in profusion, as well as other kinds of vegetables and small fruits: It is not a question of whether things will grow, but where to grow them.

There are, however, two other questions of considerable difficulty, that of building roads to reach the cultivable bench and high lands, owing to the sharp acclivity directly at the lake, and the difficulty of obtaining water for domestic purposes, when, owing to this acclivity, the lake water is not available, or where the settler is not on the lake front. In many places bed-rock is so near that digging a well would be impossible and water would have to be piped a long distance. It may prove, moreover, that in many parts, when the forest growth is cleared off, owing to the shallowness of the soil, irrigation may become imperative during the hotter part of the summer, in order to produce crops.

There are doubtless many problems in connection with the cultivation of land in this district, and I have found none more dubious about its success than those who are most concerned and who are reputed to have been most successful.

I have the honour to be, sir,
Your obedient servant.

A. O. WHEELER, D.L.S.

REPORT OF M. P. BRIDGLAND, D.L.S., ON THE SURVEY AROUND GOLDEN.

February 18, 1909.

ARTHUR O. WHEELER, D.L.S.,
Topographer,
Department of the Interior.

SIR,—The party arrived at Golden on July 18, and commenced work by looking over the land north of Golden and Kicking Horse river and east of Columbia river. This required one week, and then the work was continued southerly along the east side of Columbia river, baggage being transported by pack train. From July 26 till September 9 all the time was spent along this side except two days on which photographic stations were occupied on the west side of the river, one above Carbonate Landing and another at Jubilee mountain near the south limit of the railway belt, to complete the topographical survey of the eastern side of the valley The weather throughout was fine and warm and not much time was lost.

From September 10 to September 27 the lands along the west side of the Columbia between the south limit of the railway belt and Canyon creek were examined. As much of this section was very rough, comparatively little time was spent over it. On September 12 a third photographic station was taken midway between the two previously mentioned. From September 28 to October 23 the work was continued down the west bank of the river to the west boundary of township 29, range 23, near Donald station. Several days were lost during this period owing to heavy rain and snowfalls. Throughout all the work on this side of the river a canoe rented from Mr. Dainard, of Golden, was used for moving camp and was often of use going to and from work.

From October 29 to November 12 work was very much delayed by rains and heavy snowstorms. About four square miles north of the Donald forest reserve and east of Bluewater river were examined and then the work was continued up the valley of the Blackwater to where it becomes narrow. This section was finished on November 12, and on November 13 the party started for Golden reaching there on the afternoon of the 15th.

GENERAL INFORMATION.

The Columbia valley in the vicinity of Golden is wide, lying between the main range of the Rocky and the Selkirk mountains. Above Golden the lowest part of the valley, varying from a mile to a mile and a half in width, consists of low, wet land nearly all of which is under water through June, July and August. It is really a series of swamps through which the river flows by many tortuous channels. On either side of this flat, steep bluffs rise three hundred to five hundred feet above the river level, and beyond, a series of benches run back to the base of the mountains. Between Golden and Donald the formation of the valley is the same, but the bottom is not so wide and not so swampy.

The land may be divided roughly into two classes, bottom land and bench land; the term bottom land is applied to that part on or near the same level as the river, and bench land to that part lying between the bottom land and the base of the mountains.

Of the bottom lands practically all of the small area not liable to be flooded has been taken up except about 3,000 acres between Golden and Donald. The remainder, which is nearly all slough and swamp, is at the present time of no use except for pasture in the fall and winter. This land, if it could be reclaimed by dyking or dredging, would make the best farm land in the valley. It would probably be too wet and cold for fruit farming, but for vegetables, grain and hay it would be excellent.

On the southwest side of the river the benches are mostly rough and broken and the soil stony with frequent rock outcrops. It is a red clay with much rock, shale and gravel. There are some areas of good land, but they are so small and scattered that they would not be of any great agricultural value, and in most cases where the land is best it would be very difficult to irrigate. The greater portion of this side, south of Golden is old brulé, overgrown with small poplar, willow, jackpine and fir. Between Golden and Donald there has been no fire, but all the good timber close to the river has been taken off. There is, however, much new timber growing up, and good timber, principally spruce and fir, remains near the base of the mountains. This is all included in timber berths Nos. 14, 15, 16, 17 and 19.

On the west side of the river, between Golden and the south limit of the railway belt, the benches are not nearly so rough and stony, but they are more or less broken and it is very hard to say which are or are not too rough for cultivation. Directly above Golden the benches are narrow and rough but they start to widen in the south part of township 26, range 21. From here through townships 25, ranges 21 and 20, and township 24, range 19, they continue wide. In township 23, range 18, the valley narrows and there are no benches of any importance. To the north of Golden in

townships 27, ranges 21 and 22 there are about four square miles of good bench land much of it not badly broken. This would make excellent land if it was not too dry, but it would be very difficult to irrigate it.

The soil throughout seems to be of a very similar nature, a red sandy loam or clay usually with a gravel subsoil or occasionally a white clay. These benches are covered principally with small fir, jackpine, poplar, and willow, and when at all open there is an abundant growth of pine grass often mixed with peavine. Near the base of the mountains south of Golden there are many small streams which soon sink below the surface and many of these could be used for irrigation; as these streams would be at their highest in June and July when water is most needed, nearly all the land of value could be irrigated if any systematic attempt were made to do so.

There is very little good timber on the east side of the valley, and most of what there is consists chiefly of scattered fir along the brow of the hills above the river. Most of the merchantable timber has been cut off leaving only a few trees here and there. There is some good timber in sections 25 and 36, township 25, range 21, and sections 30 and 31, township 25, range 20 and also in the northeast quarter of section 15, the southeast quarter of section 22 and the southwest quarter of section 21, township 24, range 19, consisting of timber berth No. 421 and timber berth No. 278.

In the southwest part of township 30, range 24, north of the Donald forest reserve there are about four sections of rolling bench land covered with small poplar, willow, spruce, fir and jackpine. The soil here is a red clay loam and should make good agricultural land if not too dry but it could not be easily irrigated. There is no large timber on this land but farther north there is some good spruce included in timber berth No. 20.

Farther west in township 30, range 24, all the land examined lay along the valley of the Blackwater, five hundred feet and upwards above Columbia river. There are some large beaver meadows along the river bottom and some smaller ones on the benches above. The benches, from one mile to two miles in width, slope gently to the southwest and are not badly broken. The soil is a red clay containing considerable gravel but not enough to render it unsuitable for cultivation. Most of this section could be cultivated, and, if necessary, easily irrigated. There is much fine timber, consisting of large spruce and fir with some pine and cedar, up to thirty inches in diameter, all of which is included in timber berths Nos. 20 and 47.

Up to the present time no attempt has been made to cultivate any of the benches. The lands are harder to reach and harder to irrigate, so the settlers seem afraid to risk anything by trying them. Opinions differ widely as to their utility. Some of the settlers claim that the best land is on the benches, and others state confidently that the benches are of no use except as pasture lands. Much of the soil seems to be as good as that which they are working in the valley and would probably be more suitable for fruit growing.

Fruit farming has not been extensively tried in this valley. Some farmers have had apple trees planted for several years, and while many of the trees are in good condition, many others have been killed. There is no doubt that many of the latter could have been saved by a little care. The season is short and a winter apple such as the Northern Spy will not mature. The Wealthy and Duchess seem to be two of the varieties that do best. The trees bear heavily every year and this tends to make them short lived and also to produce an inferior class of fruit. Plums and cherries have been tried but with poor success. Small fruits such as strawberries, gooseberries and currants have yielded most abundantly wherever tried.

The climate here is a very moderate one. Snow falls early in November and remains until spring, affording excellent protection for trees and plants. The snowfall is not very heavy and many of the settlers south of Golden winter their stock on the marshes and seldom have to do any feeding. In the summer the nights are nearly always cool although the days may be hot. During July and August, 1908, the maxi-

mum temperature ranged from 70° to 90° Fahr. and the minimum from 40° to 50° Fahr.

A table showing the maximum and minimum temperatures for the time of the survey is submitted herewith; also a schedule of descriptions of the various classes of land by section, township and range has been forwarded to the Department.

I have the honour to be, sir,
Your obedient servant,

M. P. BRIDGLAND, D.L.S.

REPORT OF H. G. WHEELER ON THE SURVEY AROUND REVELSTOKE.

March 12, 1909.

A. O. Wheeler, D.L.S.,
Topographer,
Department of the Interior.

Sir,—On the arrival of the party at Revelstoke, July 19, they proceeded at once to a camp near Fourmile siding on the Revelstoke and Arrowhead branch of the Canadian Pacific railway. Some time was spent here owing to the considerable amount of good land in the vicinity. Work was pushed southward from this camp but was slow and difficult owing to the swampy and drowned land, the excessive amount of large fallen cedar and the dense growth of devil's club and thick undergrowth.

On August 19 Wigwam siding was reached. Bad weather compelled a stay here until August 26, when camp was moved on towards the railway belt boundary, the south limit of it being reached on August 31.

A return was now made to Revelstoke and, upon the arrival of a row boat hired at Arrowhead, the party took steamer up the Columbia to nineteen-mile flat, where the only settler north of Revelstoke lives, by name, James Hathaway. Work was conducted in the vicinity until September 23, being carried north to the limit of the railway belt. The steamer was then again boarded and a return made to the foot of the Petites Dalles canyon. From this point work was carried downwards on the west side of the river until the south limit of the railway belt was reached on November 14. The party was paid off on the 19th.

Through the kindness of Mr. T. Kilpatrick, superintendent of the Canadian Pacific Railway company at Revelsoke, the party was given special facilities for moving camp along the Revelstoke and Arrowhead branch and conducted the work on the west side of the river by flying camps, using the boat for crossing. North of Revelstoke, except the trips up and down by steamer, the boat was used entirely for moving camp and the purposes of the work.

GENERAL INFORMATION.

South of Revelstoke the valley of the Columbia is a trough with a width of from one to one and a half miles at its floor and about nine miles from crest to crest of the ridges forming its perimeter. The altitude above sea-level ranges from 1,500 feet at Revelstoke to 8,900 feet at the summit of Mt. Begbie, the highest crest along the valley's run.

The available agricultural area consists of bottom lands and benches extending back from the river, with a maximum elevation of a few hundred feet, to the steep mountain sides. The bottom lands are low rising but a few feet above mean water level, and a large percentage is overflowed at high water. The result is that a portion of this overflow remains in the hollows throughout the summer and swamps are formed,

thus giving to considerable areas a condition of excessive moisture. Owing to the slight elevation above the main river bed these low areas are, moreover, intersected by numerous channels for the high water flow that, at low stages of the river, carry dead water or a very sluggish current and add to the diffusion of moisture through percolation, rendering the soil cold and wet. The portion of the bottom land that is subject to yearly overflow, and where water rests in these swamps, is covered by willow brush and grown with reeds, sedge and coarse grass. It is questionable whether, owing to the slight elevation above the river, it would be possible to reclaim this land sufficiently to convert it into pasture and hay land. Much, however, might be done by dyking and allowing the surplus water to run off instead of collecting in the hollows. Owing to a peculiarity of streams like Columbia river, where the difference in extremes of water level is great (in this case about twenty feet) and very large quantities of silt are carried, the land along the banks is often higher than that farther back, through the silt being piled up along the edges of the bed, and by this means a river may raise its bed above the level of the surrounding country. In such case it would seem impossible to reclaim these overflowed lands. An approximate area for them is set at 3,912 acres.

Beyond the bottom lands, in some instances, benches are found rising back in steps to the steep mountain sides, in others the mountain slopes rise directly from the bottom lands. It is on these bench lands that farming and fruit growing will likely be carried on most successfully. But even here, owing to the intense heat in the valley during the summer months, it is doubtful whether a full measure of success can be obtained without the assistance of irrigation, and water supply for this purpose is not always attainable. The greatest height above the river at which agricultural bench land was found was 700 feet and in most cases it was considerably lower. As a rule the mountain slopes rise swiftly and are steep and rocky. While such slopes might be found suitable for the growth of small fruits, it is unlikely that fruit trees of the larger variety could be grown successfully.

The soil generally is a light sandy or clay loam with a sand or gravel subsoil. An alluvial deposit of silt is found near the river. In the low parts the alluvial deposit is overlaid by a rich vegetable mould. Near the mountain slopes gravel and stones become apparent while parts of the higher benches are often rocky. The soil is very fertile and seems well adapted to fruit growing, vegetable farming and generally to agricultural purposes. Owing to the natural heat in the valley during the summer, combined with the moisture of the lower ground, an almost tropical luxuriance of growth is produced resulting in an impenetrable jungle on the flats which, while it is the very best evidence of the productiveness of the soil, forms a highly detrimental factor to the utilization of the land for agriculture on account of the excessive cost and labour to clear it. Owing to the climatic conditions and the abundance of moisture in the valley bottom caused by the yearly overflow from the river at high water the forest growth flourishes exceedingly and immense quantities of excellent cedar and hemlock have been and are still being obtained for manufacturing purposes.

The prevailing species of merchantable timber are cedar and hemlock and these are met with on every side, in the case of the former as large as six feet in diameter. Cedar cut along the right of way of the railway sometimes measures twelve feet across the stump, but at this size they are mere shells, the whole interior being eaten up by dry rot.

There is much good timber on the west side of the river seen on the slopes of the valley in extensive patches. On the east side, while there is a scattering of good timber throughout, it has been pretty well logged over, and what is left is difficult of approach. Several good patches back on the benches and near the limit of the railway belt are still practically untouched.

Of the other species, cottonwood, poplar, birch and jackpine are most apparent, together with thick undergrowth of maple, alder and willow.

The land in and about Revelstoke is well suited for vegetable farming, and this is a great source of revenue to the settlers. All classes of vegetables will grow to perfection except those requiring very much sun, such as corn, tomatoes, &c.

Of other kinds of farming, hay seems to be the principal source of revenue. For this purpose the low bottom land and overflowed lands may furnish a good base. The latter are better adapted to it than to pasture lands for the reason that it is only for a month or a month and a half before the snow comes that they are sufficiently dry to admit of cattle roaming over them. In October, a short distance back from the railway, I came to a hay meadow. The hay was three or four feet high and I walked across it right to the mountain slope. In July I had crossed the same ground on a raft. I did not see grain growing to any appreciable extent.

The principal large fruit grown in the valley is apples; being hardy, they seem to thrive best. On visiting H. F. Hayes, one of the most successful growers, last fall, he showed me a wonderful display in his orchard. The trees were breaking down with fruit. The species bearing best were Alexander, Stark, Wealthy, Duchess, Gravenstine, Mackintosh Red and Snow. Plums do not do so well, as they require much more care and the fruit does not ripen so readily. Near Revelstoke, however, some fine specimens were seen, and it is possible that in the future when fruit growing, which is now only in its infancy in these parts, becomes more general, plums, peaches and pears will all be grown with success.

Most of the fruit trees have been set out only a few years ago, and while all the young trees seem to be doing well, it is still a little soon to speak of fruit crops in the vicinity as an assured success.

Wild fruits, such as raspberries, strawberries, huckleberries and saskatoon berries, grow in the greatest profusion and mature perfectly. This would indicate that the tame varieties can be grown with equal success, a surmise borne out by the fact that strawberries grown in Revelstoke last summer carried off first prize at the agricultural exhibit at Salmon arm. Moreover, on Williamson's ranch, adjoining that of H. F. Hayes, small fruits are now being grown extensively and successfully. It would seem possible that the sunny lower mountain slopes beyond the bench lands where the soil is always inclined to greater moisture, could be utilized to advantage in this manner.

Some of the settlers have planted out fruit trees in their holdings on the bottom lands, but it is still a matter of question whether the soil here will not be found too cold and wet to allow the fruit to ripen to perfection. All the successful fruit growing done so far has been on the high and dry bench lands, where artificial watering by irrigation has been possible.

In the Columbia river bed south of Revelstoke there are a number of islands. These are all, with perhaps two or three exceptions, practically unfit for cultivation, being below the high water level of the river and of small area. The two or three referred to are covered by a heavy growth of cedar and hemlock, and still contain trees of lumber value. The others are timbered with large poplar and cottonwood, cottonwood and willow brush and scrub. It is possible this timber may have a pulpwood value for the future. Very few of the islands were seen with a natural growth of hay to any extent. But possibly they could be used for that purpose.

Those holding homesteads are industrious and hard working. Being sure of their holdings, they do not hesitate to cultivate the land and to lay out what little capital they have. On the other hand the squatter is always in a state of uncertainty, not knowing who may reap the reward of his labour. Some of them work hard and deserve consideration. Their one cry is to have the lands under timber lease, upon which there is no merchantable timber, or insufficient to be worked advantageously, released, so that they can get their homestead entries. This is a general complaint throughout the district.

Of late years a number of Italians have been taking up holdings in the valley south of Revelstoke, not very far from the town. They make good settlers, work every bit of the ground to advantage, and raise good crops. They are very poor and on this account are at a disadvantage. They have, however, large families and will soon very materially increase the area of land under cultivation.

With regard to mosquitoes, it seems absurd to introduce these pests in a report of this nature; and yet they form an evil of considerable magnitude in the valley of the Columbia south of Revelstoke. The fact that it has been satisfactorily disposed of in other countries infested by them proves that it is not a necessary one for all time. As the country clears up, undoubtedly, the evil will be mitigated, but so long as the tracts of swamp land remain as such they will be favourite breeding grounds. It is difficult for people who live in localities where their numbers are few to understand the four months of torture that is endured here by the settlers every summer. No doubt when the settlers increase sufficiently in number, the matter will be taken in hand and the scientific application of kerosene to the swamps will put an end to what is now a serious plague.

At the present time Revelstoke furnishes the principal market for the agricultural produce of the valley, but with the facilities offered by the Arrowhead branch of the Canadian Pacific railway and that company's line of steamboats on the Arrow lakes there seems a good outlet for trade with the cities and towns springing up in the lower Kootenay country, while, when the fruit crops become of sufficient magnitude, there will undoubtedly be a market for them both east and west.

North of Revelstoke the conditions are somewhat different. The valley is much narrower and the river very rapid and difficult to navigate. It flows for the most part between high banks and is often broken by rapids. Owing to the compressed volume of the stream the difference between high and low water is great and here has an average of twenty feet while south of Revelstoke the average is about fifteen feet. The mountain slopes are very precipitous and rocky, especially on the east side.

There are no bottom lands and the land suitable for agricultural purposes consists of benches rising back in steps to the steep mountain sides. They are at an elevation of from forty to five hundred feet above the river. The available area is small It is estimated at 3,477 acres, of which probably not more than fifty per cent is fit for cultivation. While there are some level flats, the bulk of the bench land is rolling and uneven.

The soil generally speaking is either a rich black loam with a sand subsoil or a rich sandy loam with gravel subsoil, although there are variations from this rule. It is very stony in parts. Taken as a whole it is well suited for agriculture and particularly for fruit growing.

The prevailing timber of merchantable value is hemlock and cedar. The latter grows as large as six feet in diameter. There are millions of feet on the slopes on the west side of the valley. There is also a considerable quantity on the east side, but a good deal of it has been taken off to supply the mills operating at Revelstoke. Both sides of the river are completely covered by timber licenses. For the rest, cottonwood is found along the tributary streams and in low places, and jackpine in sandy spots, while second growth of cedar, cottonwood, hemlock and pine is met with in the old brulé,

The only settler on undisposed of lands north of Revelstoke, by name James Hathaway, lives on the northwest quarter of section 10, township 26, range 2, west of the sixth meridian, at a place locally known as 'nineteen-mile flat.'

The climatic conditions in the Revelstoke vicinity are exceptional. Owing to the low altitude, about 1,500 feet above sea-level, the coming of spring is comparatively early and the setting in of winter late, making a full period for growth and maturity. In addition the warm chinook effect found in wide valleys bordered by high

mountain ranges is apparent here. This, together with the large amount of evaporation from the great body of water flowing through the valley, adding humidity to the highly heated summer atmosphere, renders the climate an ideal one for the practice of farming and fruit growing.

In the winter from three to five feet of snow covers the ground and remains steadily until the spring, thus affording the best possible protection to fruit trees and a good supply of moisture for the summer. The mean average precipitation is about thirty-five inches. The valley is perfectly sheltered and there is practically no wind that is to any degree detrimental.

During July and August the maximum temperature ranged from 57° to 94° Fahr., and the minimum from 43° to 60° Fahr.; during October and November the maximum ranged from 31° to 69° Fahr., and minimum from 20° to 50° Fahr. The first frost came on September 23, when it registered 31°. On the 25th it registered 30° and on the 26th 29°. On October 4, it registered 31° and the next frost did not occur until October 16. The September frost was unusual and was universal throughout the mountain regions.

I have the honour to be, sir,
Your obedient servant,

H. G. WHEELER.

TABLE OF MAXIMUM AND MINIMUM TEMPERATURES, VICINITY OF REVELSTOKE, B.C.

During July, August, September, October and November, 1908.

	July.		August.		September.		October.		November.	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
	°	°	°	°	°	°	°	°	°	°
1			82·3	53	75	56		50	46	40
2			72	46	65	52	68	42	46	42
3			76	52		50	72	38	45	44
4			84	51	74	50·2	58	31	51	30
5			90	54	72	40	66	42	48	33
6			92	50	70	39·5	64	42	44	43
7			94	53	66	51	68	46	48	44
8			91	51	58	45·5	69	47	51	41
9			83	54	45·5	41·5	68	46	54	32
10			86	50	61	42	67	42	42	26
11			78	46			61	42	40	29
12			84	43	74	47·5	50	35	34	22
13			90	44·5	62	45	62	40	42	31
14			70	43	68	51	62	41	40	24
15					58	51	61	38	31	20
16			82		67·5	48	61	31	34	28
17			84	48	73	38	52	30	38	23
18			86	50	74	44	52	30		32
19				52	65	46	51	31		
20			78	54	75	50	44	38		
21	90	54·2	76	52	69	43	52	37		
22	92	56	74	51	66	40	52	30		
23	82·7	59·8	62	58		31	53	30		
24	80	60	62	53	55	35	51	30		
25	63	56	58	49·5	55	30	52	30		
26	76·3	43	56·5	46·5	54	29	45	38		
27	67	47		43·5	50	45	45	38		
28	66·7	52	66	52	52	41	43	32		
29	74·3	46	68	46	64	45	42	30		
30	72	48·7	70·3	47	65	36	39	30		
31	72	55	73·5	48			42	34		

TABLE OF MAXIMUM AND MINIMUM TEMPERATURES, VICINITY OF GOLDEN, B.C.

During July, August, September, October and November, 1908.

	July.		August.		September.		October.		November.	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
	°	°	°	°	°	°	°	°	°	°
1					77	47	52	42	52	26
2					65	49·5	57	40	51	31
3			76	48	74	47	57	27	43	36
4			82	47·5	80	36	58	29		34
5			85	51·5	82	38	59	32	59	35
6			83	52	87	37	58	32	44	34
7			75	49·5		55	58	31		34
8			83	49	68	42	56	29	43	26
9					68	39	64	32	35·5	26
10			87	51	66	46	63	30·5	31	21
11			78	52	66	47	73	28	27·5	14
12			73	40	67	43	63	29		
13			78	41	68	44	56	48		
14			79	40	67	56	57	38		
15				51	57	52		32		
16			82	41		49	58	27		
17			84	42	63	31	46	24		
18			86	46·5		36·5	41	26·5		
19			87	47·5	68	44	39	31		
20	85·5	45	78	49	70	47		31		
21	90	44		57	68	39				
22	91	48·5	82·5				39	24		
23	93·5	51	82	49·5		27·5	41·5	29		
24	78	49·5	69	42	50	26				
25	84·5	51	60	46	56	27·5	45	27		
26	75		60	42	51	27·5		24		
27	75	41·5	68	34		35	65	28		
28	76	41·5		48	54	40	40	26		
29	74	41·5	66	47	64	40				
30	82	44	71·5	46	63	31				
31	92	47·5	72·5	47·5			46	31		

SESSIONAL PAPER No. 25b

TABLE OF MAXIMUM AND MINIMUM TEMPERATURES, VICINITY OF SHUSWAP LAKE, B.C.

During July, August, September, October and November, 1908.

	July.		August.		September.		October.			November.		
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Lake.	Max.	Min.	Lake.
	°	°	°	°	°	°	°	°	°	°	°	°
1.				51		49·5	54	48·5		50	38·5	48·5
2.				42	61	56	63	40		50·5	41	49
3.				53·5	64·5	53·5	55	39·5		54	44	
4.			88	56·5	67·5	50·5	50	41		53	41	
5.				59	69	50·5	53	42·5		51	41	50·5
6.			91·5	50	69	51	53·5	43·5		50	42	49
7.			92·3	50	66	55·5	63	43		51	44	46·5
8.			95	47·5		46	58	43		47	38·5	48·5
9.			95	48	47	44	56	46		45·5	33·5	46
10.			86·5	43	62	44	55	44		42	28·5	44·5
11			74·5	44	65	49	55	43·5		40	28	45
12.			79	51·5	72·5	47	51	43		39	29	45
13.			83	52	65	47	57	47		45	34·5	45
14.			85·5	52	67	44	51	40	54	40·5	28	44·5
15.			83	61·5	59	40	51	39·5	55	39·5	27	44
16			79	52		47	54	38·5	54·5	41·5	33·5	46
17.			82	50·5		40	50	35	54	44	38	45·5
18.			83	53·5	65	44	47	34·5	54·5	49·5	42	46·5
19.			81	55	61	42·5	46	39	53	45·5	41	45·5
20.			78	58	73·5	50·5	42	35	52	46	40	45
21.			79·5	56·5	72·5	43·5	44·5	37	51	45·5	36·5	47
22.			79·5	54	59	41	38	31·5	51·5	44	40	46·5
23.	90·5		66	60	51	34·5	43	35·5	50 5		37	46
24.	83		62	52	55·5	27·5	45·5	37·5	51·5		36·5	45 5
25.	63	53	50	47	55·5	27·5	47	37	51		34·5	
26.	74	52	60	46·5	54	30	28·5	48	50·5			
27.	73	48	58	47	48 5	41	27·5	43	46			
28.	70	59	63	49	51	40·5	39	35·5	46			
29.	69 5	56	55·5	48	62·5	45·5	45	35	47·5			
30	78	52	58	49	61	36·5	56	41	49			
31.		52	66	47·5			46	33·5	47·5			

APPENDIX No. 50.

REPORT OF W. H. YOUNG, D.L.S.

SURVEYS IN THE VICINITY OF PINCHER CREEK.

LETHBRIDGE, February 11, 1909.

E. DEVILLE, ESQ., LL. D.,
Surveyor General,
Ottawa.

SIR,—I have the honour, in accordance with my instructions, dated April 7, 1908, to submit the following general report concerning my survey operations in southwestern Alberta during the past season.

On April 30 I went to the town of Pincher Creek where the transport outfit had been stored. The next few days were occupied in ordering supplies, hiring men and buying additional transport outfit. Upon enquiry I learned it would be advisable to procure pack saddles, &c., which I accordingly did.

On May 5 I left Pincher Creek with my outfit, and after delays on account of rains and poor trails reached section 26, township 6, range 3, west of the fifth meridian, on May 9. Owing to the high water in Southfork river, it was impossible to cross the fords on the usual trail, so we had to keep on the north side of the river. This necessitated travelling over a very hilly and rough trail, which we had to repair at the creeks, and in fact, cut anew in many places to avoid mud-holes.

Township 6, range 3, is very mountainous, most of the lines running over hills more than 1,000 feet above Southfork river. It is practically covered with small timber, jackpine and poplar, burned over some years ago, hence much of it is dead. Only in small patches along the river is the land arable. There is no timber of importance in this township. On sections 6 and 7 a quantity was cut some years ago, but fire killed what remained. In section 8 there are five exposures of coal, totalling about 40 feet, and in the bed of the river in section 15, a small but unimportant seam of hematite occurs. Two varieties of trout are very abundant in Southfork river.

After many delays on account of rains I completed all the lines, except the east boundary of the township, north of the river, and then moved camp to section 1, township 6, range 4, over high and precipitous hills. I then completed the lines in the southwest part of the township. From this camp I also surveyed a portion of township 5, range 3, and found it advisable to move a flying camp south by pack horses. Accordingly I cut a trail to section 30, from which camp I completed the survey of the township. By this time the river had lowered sufficiently to allow us to cross, and so I moved to the east side of township 6, range 3, to the south side of the river and completed the township. There are quite a number of settlers in the township, nine of whom made their declarations.

Township 5, range 3, is covered mostly with spruce along the west boundary, much of the interior having been burned. Black and brown bears and red deer were numerous in this and the adjoining township to the west.

After completing the survey of township 6, range 3, I moved to township 7, by way of the Pincher Creek-Frank trail as far as Burmis on the Canadian Pacific railway, then north by settlers' trails and roads. I surveyed the north and east boundaries of sections 34 and 35. On the north boundary monuments were already established, but not in correct position, so I destroyed them. The north part of this township

is of little use except for grazing, being partly covered with poplar and willow scrub. I next proceeded to township 7, range 4. This is an extremely rough and mountainous township, abounding in deep canyons and rocky ledges, some timber has already been cut but a little still remains.

I moved my outfit to Pincher Creek en route to township 3, range 30, west of the fourth meridian. On my arrival at Pincher Creek I found instructions awaiting me to complete the survey of township 6, range 2, west of the fifth meridian.

The southerly portion of this township is very mountainous especially in the south-west part, and fit for little else than grazing, but along Screwdriver creek and South-fork river there are many quarter sections suitable for farming. Good crops of oats and wheat, as well as excellent vegetables, were grown here last summer. Coal deposits are numerous in this township.

From township 6, I returned to Pincher Creek, and proceeded south by the Oil City trail as far as Dry Fork post-office, and then in a southwesterly direction over a fairly good trail to section 33, township 3, range 30, west of the fourth meridian.

Part of this township is suitable for farming, but is better adapted for ranching, There is no timber, but immense quantities of willow brush are found. The soil is a light sandy loam and the grass is not too plentiful, but may be cut for hay in the south part of the township. On section 22, a small crop of oats was cut before ripening. Iron claims have been staked in section 12 and the adjoining section. The southwesterly part of the township is a barren waste of rocky mountain peaks. In the last week of September snow fell to the depth of three feet, and this, together with other storms in October, delayed us considerably.

Township 4, range 1, west of the fifth meridian is suitable in parts for farming and a number of settlers there have made declarations.

The southeasterly portion is suitable only for ranching, while mountain peaks occupy the west half and southwesterly part. Upon the completion of that portion of this township which I considered fit for agriculture I proceeded to Pincher Creek, where I stored my outfit for the winter, dismissed my party and departed, arriving in Lethbridge on November 4.

I learned from enquiry here that Keho lake was more of the nature of a muskeg; I therefore decided to investigate this after it was well frozen. I engaged two men and drove to this lake. I found little or no water, but settlers told me that in the spring it floods a great portion of the country. I took measurements to enable me to determine the legal subdivisions which are rendered altogether worthless by water.

I have the honour to be, sir,
Your obedient servant,

W. H. YOUNG, D.L.S.

DESCRIPTIONS OF TOWNSHIPS

DESCRIPTIONS

OF

SURVEYED TOWNSHIPS

1908-1909

APPENDIX No. 51.

LIST OF TOWNSHIPS DESCRIBED.

EAST OF PRINCIPAL MERIDIAN.

Township.	Range.
16, 24, 25, 28	1
24, 25	2
18, 24, 25	3
25	4
16	7
20, 21, 22, 23, 24, 25, 26	8
20, 24	9
18	11
16	12
10	13
10, 14, 15	14
2, 3, 4, 5, 6, 7, 8, 10, 12	15
12	16
12	17

WEST OF PRINCIPAL MERIDIAN.

Township.	Range.
24, 25, 26, 27, 28	1
24, 25, 26, 27	2
24, 25	3
25	4
24, 25	5
25	6
25, 26	7
25, 26	8
25, 26	9
27, 28, 29, 30, 31	10
22, 23, 27, 28	11
27, 28	12
27, 28	13
27, 28, 29, 30, 31	14
30, 31	15
31, 32, 36	16
33, 34, 35, 36	17
28	18

WEST OF PRINCIPAL MERIDIAN—*Con.*

Township.	Range.
23, 35	20
23, 31	21
29, 30	23
26	24
23	26
24	30
29, 30, 31	31

WEST OF SECOND MERIDIAN.

21, 38	1
38	2
38	3
37	5
32, 42, 43	9
41, 42, 43	10
41, 42, 43	11
50, 51, 52	14
41, 51, 52	15
41, 42, 51	16
41, 50, 51	17
50, 51	18
1, 4, 50	19
1, 2, 3, 4	20
2, 3, 4, 46, 51	21
1, 2, 44, 46, 49	22
1, 2, 49	23
1, 2, 3, 47	24
1, 2, 3, 47, 49	25
1, 2, 3	26
1, 2	27
1	28

List of Townships Described—*Continued.*

West of Third Meridian.

Township.	Range.
23, 42, 43, 44	1
6	2
6, 7, 8, 9, 10, 24, 52	3
5, 6, 7, 8, 9, 23, 24, 52	4
5, 6, 7, 8, 9	5
5, 6, 7, 8, 9, 10	6
5, 6, 7, 8, 9, 10	7
5, 6, 7, 8, 9, 10	8
7, 8, 9, 10	9
5, 7, 8, 9, 10	10
5, 6, 7, 8, 9, 10	11
5, 6, 7, 8, 9, 10	12
5, 6, 7, 8, 9	13
7, 8	14
7, 8	15
5, 7, 51	16
5, 7	17
5, 6, 7	18
5, 6, 7	19
4, 5, 6, 7	20
5, 6, 7	21
5, 6, 7	22
5, 6	23
1, 2, 3, 4, 50, 51, 52, 53	26
1, 2, 3, 4	27
2, 3	30

West of Fourth Meridian.

59, 60	1
1, 2, 3, 4, 5, 59, 60	2
1, 2, 3, 4, 5, 59, 60	3
1, 2, 3, 4, 5, 59, 60	4
3, 4, 5, 59, 60, 61, 62	5
59, 60, 61, 62	6
3, 4, 5	7
3, 4, 5	8
3, 4, 5	9
63, 64	13
27, 28, 29, 30, 31, 32, 63, 64, 65	14
27, 28, 31, 32, 63	15
27, 28, 31, 32, 41	16
27, 28, 29, 30, 31, 32, 41, 42, 43	17
27, 43, 44, 60	18
32, 44, 60, 63, 64, 65, 67	19
34, 60, 63, 64, 67	20
59, 60, 64, 66, 67	21
60, 64, 67	22
61, 62, 63, 64, 65, 66, 67	23
61, 62, 63, 64, 65	24
62	27
3, 9	30

West of Fifth Meridian.

Township.	Range.
4, 5, 6, 7, 8, 61, 62	1
6, 12, 13, 60, 61	2
5, 6, 8, 9, 10, 12, 13, 61	3
8, 12, 45, 46, 61	4
22, 23, 45, 46, 53, 61	5
45, 46, 61, 62	6
49, 50, 51, 52, 57, 61, 62	7
40, 52, 58	8
40, 44, 52, 55, 56, 57, 58, 59, 60	9
40, 44, 52, 55, 56, 57, 58, 59, 60	10
40, 44, 54, 55, 56, 57, 58, 59, 60	11
40, 44, 54, 55, 56, 57, 58, 59, 60	12
40, 44, 54, 55, 56, 57, 58	13
40, 44, 53, 55, 56	14
40, 44, 52, 53, 55	15
40, 44, 52	16
40, 44, 52	17
40, 44, 48, 52, 53	18
40, 43, 44, 48, 52, 53	19
43, 44, 48, 52, 53, 56	20
48, 52, 56	21
48, 52, 53, 56	22
48, 52, 53, 56	23
48, 52, 56, 81, 82	24
48, 81	25
48	26
48, 49, 50	27
48	28

West of Sixth Meridian.

79, 80	3
80	4
77, 78, 79	5
19, 20, 21	12
19, 20	13
19, 20	14
19, 20	15
18, 19, 20	16
21, 22	17
20	21
15, 16, 23	22
20, 23	23
19, 20	24
17, 18, 19	25
16	26

DESCRIPTIONS OF TOWNSHIPS.

NOTE.—Numbers of townships are placed in heavy type on the left margin of the pages in the descriptions of townships.

TOWNSHIPS EAST OF THE PRINCIPAL MERIDIAN.

Range 1.

10. The soil in this township is said to be of an inferior quality, but the township is being gradually filled up with a hardy class of settlers who speak in very hopeful terms of their prospects and who will give a good account of their farming operations in the near future. The land has been stripped of whatever forest originally existed on it, and only sufficient timber remains now for fuel, fencing and building necessities of the settlers. There are many large sloughs in this township and water is abundant.—*C. F. Aylsworth, D.L.S., 1908.*

24. This township is situated about twenty-five miles in a northwesterly direction from Hnausa postoffice, on the west shore of lake Winnipeg, and may be approached either by means of what is known as Fisher river road or by way of Icelandic river road from Vidir. Vidir is the nearest postoffice being only about two miles southeast of the township. The character of the soil of this township is chiefly that of a sandy loam underlain by a limestone gravel, or in many cases solid limestone rock. The easterly half of the township is high and comparatively dry, but the westerly portion is largely occupied by an extensive swamp, around which toward the north we found considerable difficulty in making a road. The most westerly mile of the township is composed of a high limestone plateau, which breaks off abruptly toward the east into the swamp already mentioned. This plateau is about fifty feet above the adjoining swamp lands. This township like others in the vicinity has been swept by fire at some time during the past few years and consequently no timber of any value was found. The general character of the surface may be described as 'brulé' containing a few large, dead, standing stubs and many fallen trees. The growing timber is all of very small size, from one to three inches in diameter. The swamp lands, occupying portions of sections 16, 17, 20 and 21 as well as some other localities contain a considerable amount of swamp hay, although during the time of survey, August they were so flooded by the incessant rains as to be almost inaccessible and entirely too wet to admit of cutting. Most of the northeast and easterly part of this township is comparatively high and dry, but a large amount of water was found on the westerly and central sections lying immediately to the east of a pronounced limestone ridge, which occupies the greater part of the westerly tier of sections. No creeks or ponds were met with and no water-power occurs in this township. Judging from the growth of vegetation in this locality I would say that the climate is quite favourable for the pursuit of general farming. No summer frosts were experienced and during the past season the weather was extremely wet and productive of great growth. Occasionally the summer temperatures are exceedingly warm, although somewhat tempered by cool breezes either from lake Winnipeg or lake Manitoba. During the winter season the weather is usually fine and cold, forty degrees below zero being about the lowest temperature recorded during the past winter. The fuel supply of this township is limited to the standing dead or fallen timber, which however in some localities is very abundant, particularly in the eastern portion of the township. A large amount of limestone rock outcrops in the more westerly portion of this township and although much weathered and of a very shaly nature where exposed on the surface, it is quite

possible that if opened up as a quarry it might yield a fairly good building stone. Other than the limestone no minerals of economic value are known to occur in this township. Small game such as prairie-chicken and ruffed grouse were occasionally met with in this locality, but the only species found of any consequence is the moose, which is comparatively common throughout the district.—*J. W. Tyrrell, D.L.S., 1907.*

25. The township is situated at a distance of about thirty-five miles in a northwesterly direction from the village of Hnausa on the shore of lake Winnipeg, and may be most easily approached by means of a fairly good wagon road from that place, Vidir being the next postoffice, from which place it is only about ten miles distant. A large percentage of the soil of this township is of a very rocky character, bare limestone appearing at the surface in very many places. The southwesterly portion of the township is particularly rough and rocky and is scarcely suited for agricultural purposes. The northeasterly part of the township, though rocky in places, contains a large amount of swamp land. The surface of this township is considerably broken and hilly, although no very great elevations occur. The most conspicuous hill in the township has an extreme elevation above the surrounding country of about fifty feet and passes in a northwesterly direction through sections 12, 11, 14 and 15, and is of a very rocky character. The greater part of the township, like others in the locality, has been burnt over within recent years, so that little living timber of any value remains. In some sections there is a large quantity of standing dead timber which, if available for market, would be of very considerable value. The southwesterly part of the township which, as already stated, is of a rocky character, is of a comparatively high elevation and is quite dry, but to the northeast it is quite wet, containing in addition to a large tract of swamp land, a lake of considerable size occupying parts of sections 23, 24, 25, 26, 35 and 36. No timber of any value now remains. This township being of a rather dry, rocky character, comparatively little natural hay was found. Some, however, occurs upon sections 3, 4, 7, 8, 9, 17, 20, 21, 33 and 34. The northeastern part of this township is well supplied with water from a large lake already referred to upon sections 23, 24, 26, 35 and 36. A small creek passes through sections 6 and 7 and during the early part of the summer contains a good flow of fresh water; but this is not constant and was found to be completely dry during the latter part of the season. In addition to the above sources there is also a large surface supply in the extensive muskegs in the northeasterly part of the township. No water-power occurs upon this township. The climate of the locality is similar to that of the other eastern parts of Manitoba, though probably somewhat more moist on account of the proximity of the great lakes both to the east and west. Hard frost sets in about the middle of November sufficient to freeze the swamps and smaller lakes. Snow usually follows within a week or two. The climate seems to be quite favourable to the successful growing of oats, barley, wheat and all the ordinary root crops; for these were successfully grown during the past summer both in township 25, range 1, west of the principal meridian and at Fisher River Mission station. There is an abundant fuel supply upon this township in the form of dead timber which is still standing in large quantities. This township being of a very rocky nature with many limestone exposures at the surface may at some time furnish stone for building purposes, but as yet no quarries have been opened. No minerals of economic value are known to exist upon this township. The most important variety of game in the vicinity is the moose which is comparatively numerous. Elk or wapiti are also found and black bear are not uncommon. Timber wolves are reported to exist, though no signs of them were observed. Of feathered game the supply is very limited, being confined to a few ruffed grouse, spruce-partridge, prairie-chicken and duck, the latter being very scarce.—*J. W. Tyrrell, D.L.S., 1908.*

Range 1—Continued.

23. This township is situated immediately south of Indian reserve No. 44, which adjoins the southern extremity of Fisher bay of lake Winnipeg. A road, known as the Fisher river road passes from the Mission station at Fisher bay through the northeasterly part of this township in a southeasterly direction to Icelandic river on the shore of lake Winnipeg. By means of this road this township is accessible from either place, except during the wet seasons, when the portion of the road through the south of it is next to impassable. The soil of this township is chiefly of a very stony character and will be more suitable for ranching than for farming purposes. The surface is comparatively level with slight variations in elevation, the higher portions of which are of a rocky nature, whilst the lower ground is occupied by tamarack swamps or muskegs. The surface of the higher country is chiefly covered by small poplar woods, the swampy country by tamarack. A limited quantity of big spruce, tamarack and poplar occurs upon the northeasterly sections of the township immediately adjoining the south boundary of the Indian reserve, but beyond this locality there is no timber of any considerable value. A considerable amount of marsh hay occurs upon sections 1, 5, 6, 15, 16, 17, 18, 21, 22, 24, 29, 30, 31 and 32. The only water supply found occurs in the muskegs occupying parts of sections 13, 14, 15, 16, 17, 21, 22, 29, 30, 31 and 32. No water-power occurs upon this township. The climate of the locality is similar to that of the other eastern parts of Manitoba, though probably somewhat more moist on account of the proximity of the great lakes both to the east and to the west. Hard frost sets in about the middle of November sufficient to freeze the swamps and smaller lakes. Snow usually follows within a week or two later. The climate seems to be quite favourable to the successful growing of oats, barley, wheat and all the ordinary root crops; these were successfully grown last summer both in township 25, range 1, west of the principal meridian and at Fisher River Mission station. The only kind of fuel found in this township is a limited amount of large timber occupying a portion of the eastern sections of the township, where there is a considerable amount of poplar, jackpine, spruce and tamarack, sufficient for local supply. This township being of a rocky character with many limestone exposures at the surface may at some time furnish stone for building purposes, but as yet no quarries have been opened. No minerals of economic value are known to exist upon this township. The most important variety of game known in the vicinity is the moose which is comparatively numerous. Elk or wapiti are also found and black bear are not uncommon. Timber wolves are reported to exist, though no signs of them were observed. Of feathered game the supply is very limited, being confined to a few ruffed grouse, spruce-partridge, prairie-chicken and duck, the latter being very scarce. —*J. W. Tyrrell, D.L.S., 1908.*

Range 2.

24. This township which is situated about twenty miles to the northwest of Hnausa on the shore of lake Winnipeg, is most easily approached from there by way of what is known as the Fisher river road, which passes through the northeasterly sections of the township. During wet seasons the condition of this road is extremely bad, almost impassable, while during dry seasons, or in the winter time, it affords a first class means of transportation. The general character of the surface soil of this township is that of a sandy loam, approaching gravel in many localities and it is underlain in most places by limestone gravel or rock. For the most part the surface of this township is comparatively level, although several gravel ridges occur in it, the most notable of which passes in an easterly and westerly direction through the northern tier of sections and forms a remarkably well defined ridge of about thirty feet in height. In addition to

these gravel ridges there is a cliff of limestone about forty feet in height which extends in a northwesterly direction across sections 29, 32, and 31. From the centre of this township and extending about one and one-half miles towards the west there is situated a very extensive, soft muskeg, over which we found it very difficult to make a crossing. Almost the entire surface of this township may be described as what is commonly known as brulé, fire having swept the whole district some five or six years ago. The growing timber of the township is therefore of very small size, being chiefly white and black poplar, jackpine, scrubby spruce, tamarack and willow. A large quantity of natural marsh hay occurs on the several sections of this township, notably sections 3 and 4, besides in and about the large muskeg occupying the westerly portion of the township to which we have already referred.

During the past season the water was so deep in this muskeg that comparatively little of the hay was accessible for cutting, but during a fairly dry season a very large amount of hay would be available upon sections 16, 20, 21, 28, 29 and 32. No fresh water streams occur upon this township, but the whole western and southerly portion of the township contains abundance of water in the hay marshes. The northeastern portion of the township is very dry, no water of any description being found. No water-power occurs upon the township. Judging from the growth of vegetation noted in this locality I would say that the climate is quite favourable for the pursuit of general farming. No summer frosts were experienced and during the past season the weather was extremely wet and productive of great growth. Occasionally the summer temperatures are exceedingly warm, although somewhat tempered by cool breezes either from lake Winnipeg or lake Manitoba. During the winter season the weather is usually fine and cold, forty degrees below zero being about the lowest temperature recorded during the past winter. The fuel supply of this township is limited to the standing, dead or fallen timber, which, however, in some localities, is very abundant, particularly in the western part of the township. In the northeastern part of the township there are some bluffs of jackpine sufficiently large to be used as firewood but they are quite limited in extent. The formation of this township, like all those of the district, is composed of limestone and upon sections 29, 31 and 32 this outcrops in the form of a solid ridge of rock of about forty feet in height. The surface of this outcropping of limestone was much weathered and shaly, but it is quite possible that if a quarry were opened rock suitable for building material might be found. Other than the limestone above referred to no minerals of economic value are known to occur in this township.

Small game such as prairie-chickens and ruffed grouse were occasionally met with in this locality, but the only species of game found of any consequence is the moose which is comparatively common throughout the district.—*J. W. Tyrrell, D.L.S., 1907.*

25. This township is situated about fifteen miles west from the shore of lake Winnipeg and about twenty-five miles in a northwesterly direction from Hnausa post-office, from which place it may be reached by means of Fisher river road, which passes in a northwesterly direction through the township. The surface of this township is exceedingly stony and rocky in character, being composed of limestone gravel, or in some cases the bare limestone rock and consequently it is not suited for farming purposes. This township is like others of the district, comparatively level, except at the extreme southeasterly corner where there is a well defined gravel ridge of about thirty feet in height, passing in a northeasterly and southwesterly direction. Much of the township has been swept by fire and is therefore composed of brulé, with some standing dead timber and an enormous amount of deadfall, through which in some places it is very difficult to travel. Some bands of green jackpine, however, occur

Range 2—Continued.

in several places. No timber of any commercial value occurs upon this township, the only live timber of any size being some bands of jackpine of from two to four inches in diameter. A considerable amount of natural marsh hay occurs in this township chiefly upon sections 6, 7, 17, 18, 22, 23, 19, 30 and 31. The township being of a stony rocky character possesses less surface water than most others in the vicinity. However, a lake, nearly two miles long occurs in the southwesterly portion of the township, occupying parts of sections 5, 6 and 7, and from the north end of this lake a wet hay marsh extends through sections 18 and 17. Good water may also be found in a large slough on the northwest quarter of section 23. No water-power occurs upon this township. Judging from the growth of vegetation in this locality I would say that the climate is quite favourable for the pursuit of general agriculture. No summer frosts were experienced and during the past season the weather was extremely wet and productive of great growth. Occasionally the summer temperatures are exceedingly warm, although somewhat tempered by cool breezes either from lake Winnipeg or lake Manitoba. During the winter season the weather is usually fine and cold. Forty degrees below zero was about the lowest temperature recorded during the past winter. An enormous amount of dry wood occurs in the brulé district of this township, some of which is still standing, but a great portion of which is down in the shape of heavy windfall. Some green jackpine woods also occur capable of supplying a very considerable amount of fuel for future use. Although nothing in the shape of a stone quarry has been opened up in this township, the entire surface is underlain by limestone rock, which in many places crops out on the surface. This rock though much weathered and fractured where exposed, might in all probability furnish a serviceable quality of building stone if quarries were opened up. No minerals of economic value are known to occur in this township. Small game such as prairie-chicken and ruffed grouse were occasionally met with in this locality, but the only species of game found of any consequence is the moose, which is comparatively common throughout the district.—*J. W. Tyrrell, D.L.S., 1907.*

Range 3.

18. The soil of this township is all of third class quality and about twenty-five per cent of it is hay meadow. There is enough timber remaining for fuel purposes for a few years to come. There are a few settlers in the township who live by ranching on a small scale and fishing in lakes Manitoba and Winnipeg. Very little farming has been done yet by the settlers only to provide garden material for their own necessities.—*C. F. Aylsworth, D.L.S., 1908.*

24. This township is situated only about six miles from the west shore of lake Winnipeg and about twenty miles in a northwesterly direction from Hnausa postoffice, from which place it is accessible by means of the Fisher river road, which passes through the southwesterly portion of the township. With the exception of the northwesterly portion of this township, which is composed chiefly of sandy clay with clay subsoil, this township is composed almost entirely of swamp land, which in some places is so soft during the open season as to be quite impassable for a pedestrian. This applies more particularly to the southerly central portion of the township. The surface of this township is comparatively level and is chiefly covered by small white and black poplar and swamp spruce, although portions of it consist of very soft open muskegs where little timber of any description is found. Comparatively little valuable timber exists in this township, but heavy poplar woods were met with on sections 1, 2, 6, 12, 27, 28, 33 and 34. This township being composed chiefly of swamp and marsh land contains an abundance of marsh hay, although during the past season the greater

portion of it was inundated. No water-power is found in this township. Judging from the growth of vegetation noted in this locality I would say that the climate is quite favourable for the pursuit of general agriculture. No summer frosts were experienced and during the past season the weather was extremely wet and productive of great growth. Occasionally the summer temperatures are exceedingly warm, although somewhat tempered by cool breezes either from lake Winnipeg or lake Manitoba. During the winter season the weather is usually fine and cold. Forty degrees below zero was about the lowest temperature recorded during the past winter. The heavy poplar woods already referred to contain a large amount of good firewood. No stone quarries nor minerals of economic value occur in this township. Small game such as prairie-chicken and ruffed grouse were occasionally met with in this locality, but the only species of game found of any consequence is the moose, which is comparatively common throughout the district.—*J. W. Tyrrell, D.L.S., 1907.*

25. This township is situated within a mile of the west shore of Washow bay, lake Winnipeg, and may be approached from Hnausa by means of Fisher river road, which passes within about two miles of the southwest corner of the township; or during the winter season it may be more conveniently approached from Icelandic river by means of a road crossing the muskegs in a northerly direction, and passing within half a mile of the east boundary. The soil of this township in the western portion is of a very stony character, underlain by limestone rock, while in the eastern portion of the township it is chiefly of a swampy nature, apparently of little use anywhere for agricultural purposes. The general character of the surface of this township is extremely flat with slight drainage toward the east. The western portion of the township is composed chiefly of brulé, while the eastern part which is of a very swampy nature is covered chiefly with small poplar scrub and swamp spruce. Very little timber of any consequence occurs upon this township, the only block worth mentioning occupying part of sections 23 and 24, where some good spruce, tamarack, birch and balsam were observed. Although this township contains a large percentage of swamp land, very little marsh hay was observed, although in many cases small quantities might be obtained, and it is possible that during dry seasons much of the flooded lands might be productive of a considerable quantity of marsh hay. A large percentage of the surface of this township is of an extremely wet character, particularly toward the east and south. In the southwest quarter of section 10 a small spring creek has its source in a pond surrounded by bubbling springs and flows in a southeasterly direction leaving the township at the southeast corner of section 3. This creek contained fine, clear fresh water and at its source was open throughout the winter season. No water-power occurs upon this township. Judging from the growth of vegetation in this locality I would say that the climate is quite favourable for the pursuit of general agriculture. No summer frosts were experienced, and during the past season the weather was extremely wet and productive of great growth. Occasionally the summer temperatures are exceedingly warm, although somewhat tempered by cool breezes either from lake Winnipeg or lake Manitoba. During the winter season the weather is usually fine and cold. Forty degrees below zero was about the lowest temperature recorded during the past winter. The fuel supply of this township is not very abundant, being limited to some small bluffs of green timber, the most notable of which occur upon sections 3, 4, 16, 23, and 24. No stone quarries, nor minerals of economic value occur in this township. Small game such as prairie-chicken and ruffed grouse were occasionally met with in this locality, but the only species of game found of any consequence is the moose, which is comparatively common throughout the district.—*J. W. Tyrrell, D.L.S., 1907.*

TOWNSHIPS EAST OF THE PRINCIPAL MERIDIAN.

Range 4.

25. This township is situated on the south shore of Washow bay, lake Winnipeg, and consequently during the summer season is most easily approached by water. During the winter season it may be reached by means of a good sleigh road from Icelandic river, passing through the muskegs and into the southwest portion of the township. A large percentage of the soil of this township is of a mossy character with clay subsoil. Some good loam with clay subsoil is found about the shore of the bay on sections 17, 18, 19 and 20, but marsh land extends for a greater or less width all along the water front. The general surface of this township is very level with a slight fall toward the north and is chiefly covered with timber, which in some localities is of good size and quality. This township is more than usually well supplied with timber, which is composed chiefly of spruce, tamarack, birch and poplar. Some of the best of this timber would vary from ten to fifteen inches in diameter and appears to be of good quality. The sections upon which the best timber was noted are as follows: 1, 2, 4, 5, 8, 15 17, 20, 22 and 24. During favourable seasons a large amount of hay land is accessible in this township, though I was informed by a settler on section 20 that during the past season he was unable to cut any hay where he had previously done so for years. Some of the best hay sections are 8, 9, 10, 18, 19, 20, 21 and 29. This township possesses a water front to the north, Washow bay occupying the whole or part of sections 25, 26, 27, 28, 29, 32, 33, 34, 35 and 36. There are also some extensive wet marshes extending through the township from the bay in a southerly direction. No streams of any size pass through the township nor are there any water-powers. Judging from the growth of vegetation noted in this locality, I would say that the climate is quite favourable for the pursuit of general farming. No summer frosts were experienced and during the past season the weather was extremely wet and productive of great growth. Occasionally the summer temperatures are exceedingly warm, although somewhat tempered by cool breezes either from lake Winnipeg or lake Manitoba. During the winter season the weather is usually fine and cold, forty degrees below zero being about the lowest temperature recorded during the past winter. This township possesses an abundant fuel supply in the heavy forest which covers a large percentage of its surface. Nothing in the shape of opened stone quarries occur in this township, although on the south boundary of section 2 there is a large outcropping of limestone rock, which if opened up might furnish a serviceable quality of building stone. Other than the limestone referred to, no minerals of economic value are known to occur upon this township. small game such as prairie-chicken and ruffed grouse were occasionally met with in this locality, but the only species of game found of any consequence is the moose, which is comparatively common throughout the district.—*J. W. Tyrrell, D.L.S., 1907.*

Range 7.

16. The eastern portion of the area surveyed consists of jackpine, sand and gravel ridges; the western portion consists of tamarack, spruce and a few scattered scrubby muskegs. Portions of these muskegs may be reclaimed for agricultural purposes in the future, as the water seems to flow rapidly towards lake Winnipeg.—*C. F. Aylsworth, D.L.S., 1908.*

Range 8.

20. (North outline.) This line being less than half a mile in length, runs through heavy spruce, tamarack, birch and balsam to the east shore of lake Winnipeg. Cordwood was taken out along this line some years ago.—*B. J. Saunders, D.L.S., 1907.*

20. (East outline.) A small bay of lake Winnipeg intersects the east boundary of section 1. Throughout the rest of the township the line runs through level, wet coun-

try, consisting of tamarack and spruce swamp, with a few small open muskegs. The soil is third and fourth class.—*B. J. Saunders, D.L.S., 1907.*

20. This fractional township lies on the east side of lake Winnipeg. There is a good strip of land about twenty chains wide parallel to the edge of the shore of the lake, of good first class soil composed of the best black loam. It is also well timbered with spruce, tamarack and a good percentage of ash and elm. It is notable that there are a good many spruce of large size, from thirty-six to forty inches, straight and tall. Besides the strip above described, the township is muskeg with a dense growth of black willow scrub and small spruce three or four inches in diameter. The banks of the lake vary from ten to fifteen feet high. The beach is alternately muddy, sandy and stony.—*A. Bourgeault, D.L.S., 1908.*

21. (East outline.) Much of this line falls in lake Winnipeg which it crosses five times. The country is generally wet and level, consisting of spruce and tamarack swamp, while, the shores of the lake being low and marshy, dense willow and alder also occur. This outline crosses the south boundary of the Black River Indian reserve about ten chains south of the northeast corner of section 25, the reserve extending north throughout the rest of the township. Where the line crosses Black river, the stream is about half a mile wide. The soil is third class.—*B. J. Saunders, D.L.S., 1907.*

22. (East outline.) Commencing in a bay of lake Winnipeg the line enters heavy spruce and tamarack swamp on the east boundary of section 12. Throughout the rest of its length the country remains generally wet, there being a few small clumps of poplar on the dry ground. Open muskegs occur on the east boundaries of sections 25 and 36, the northeast corner of the township falling in the latter one, which extends far to the east. The soil is third and fourth class.—*B. J. Saunders, D.L.S., 1907.*

23. (East outline.) The line commences in open muskeg, but the country changes near the middle of the east boundary of section 1 into heavy spruce and tamarack swamp which runs north to section 25, where the country becomes a little higher and spruce, poplar and balsam occur. Sandy river, a sluggish stream about four chains in width, crosses the east boundary of section 25, about twenty chains south of the northeast corner. Heavy spruce, balsam, birch, poplar and tamarack continue to the northeast corner of the township. The soil is fourth class.—*B. J. Saunders, D.L.S., 1907.*

24. (North outline.) The line commences in a spruce and tamarack swamp, but the country changes almost immediately to gently rolling country covered with spruce, birch, tamarack, balsam and pitch-pine. This line intersects the east shore of lake Winnipeg on the northern boundary of section 33, at a point twenty-one chains west of the quarter section corner. Most of the larger timber was taken out several years ago. The soil is third and fourth class.—B. J. Saunders, D.L.S., *1907.*

24. (East outline.) This line commences in heavy spruce, balsam, birch, poplar and tamarack, but the country changes into heavy spruce and tamarack swamp near the middle of the east boundary of section 1. Several rock outcrops occur, and near the middle of the east boundary of section 13 the country becomes rolling, and poplar, spruce, birch, balsam and pitch-pine occur. Near the middle of the east boundary of section 25 the country changes again to spruce and tamarack swamp, which continues to the northeast corner of the township.—*B. J. Saunders, D.L.S., 1907.*

TOWNSHIPS EAST OF THE PRINCIPAL MERIDIAN.

Range 8—Continued.

25. (East outline.) The line commences in a spruce and tamarack swamp, but the country almost immediately becomes rolling and covered with spruce, balsam, birch, poplar and tamarack. A few ash also occur. The mouth of Manigotagan river crosses the east boundary of section 12, being about half a mile wide. On the north side of the river a strip of fire-killed poplar is found along the bank, but the country soon changes into spruce and tamarack swamp with a few patches of windfall. On the east boundary of section 24 the country becomes rolling and spruce, poplar, balsam, pitch-pine and birch occur, which continue to within twenty chains of the north-east corner of the township, where the country changes again into spruce swamp. The soil is third and fourth class.—*B. J. Saunders, D.L.S., 1908.*

26. (Part east outline.) This line strikes the bank of lake Winnipeg about twenty chains north of the southeast corner of the township, running through poplar, birch and balsam. The bank of the lake is rocky and precipitous.—*B. J. Saunders, D.L.S., 1908*

Range 9.

20. A great portion of this township is mostly muskeg, low and wet land. About eighty per cent of its surface is muskeg, covered with a dense growth of black willow scrub and black spruce of small size, good only for fuel. The moss in some places attained a depth of four to five feet, sometimes overgrown with poor hay. There are a few scattered bluffs of spruce and tamarack good for ties and a great many good only for rails. There is a timber belt along the north boundary about half a mile wide of good size spruce and tamarack, suitable for timber. This belt is, or should be, included in the Black River timber berth. There is a timber berth No. 1252 of four square miles. I noticed during the progress of the survey that all the timber good for ties had been cut on this timber berth, amounting to 15,000 and a few hundred logs; this enabled me to take a fair estimate of the rest of this township, amounting to about 35,000 ties and 2,000 logs of spruce and tamarack besides the poplar. This township is not good for farming purposes. The twenty per cent of high and dry land is for the most part stony and very often rock. However, the wet portion may be readily drained into lake Winnipeg.—*A. Bourgeault, D.L.S., 1908.*

20. (North outline.) This line commences in a spruce and tamarack swamp and the country almost immediately becomes rolling and covered with dense poplar and birch which change to heavy spruce, balsam, tamarack and pitch-pine near the north-east corner of section 31. This latter class of country continues generally throughout the township, the hollows consisting of tamarack and spruce swamp. Several rocky ridges of a generally northeast direction occur. The soil varies from third to fourth class.—*B J. Saunders, D.L.S., 1907.*

24. (North outline.) This line commences in spruce and tamarack swamp, but the country immediately becomes rolling and rocky and covered with heavy spruce, pitch-pine, birch, balsam and tamarack. This class of timber continues east to the corner of the township. The line crosses Manigotagan settlement in sections 31, 32 and 33. Manigotagan river crosses the north boundary of section 35, being about five chains in width. The soil is third and fourth class.—*B. J. Saunders, D.L.S., 1908.*

Range 11.

18. This township is generally level country, but numerous rocks which emerged above the surface makes its general aspect broken. Besides the rocks which occupy about twenty per cent of surface a good deal is muskeg or swamp covered with dense

Range 11—Continued.

black willow scrub and black spruce of small size but generally long and good for rails. The remainder is good soil, ranks first class, is composed of black loam and clay subsoil, and is well timbered with spruce, poplar and scattered tamarack from ten to fifteen inches in diameter. However, in the margin of the rocks there is plenty tamarack of large size suitable for any requirement of the market, especially for piles and ties. There is a little river, a tributary of Maskwa (Bear) river, which crosses the township in a southwesterly direction through sections 24, 14 and 10 and from this last section in a northeasterly and north direction through sections 16, 17, 18 and 20, with an average width of thirty-five links and an average depth of three feet, good for rafting, but numerous dead trees are jammed here and there which render rafting difficult. There is another river about the same size which crosses section 1 in a southwesterly direction, emptying into Winnipeg river. The water in this river is supplied by muskegs and is black (sometimes called Indian water). However it is good to drink. On both sides of these rivers lie splendid belts of white spruce, and here and there in the small valleys are seen elm and ash fit for the settlers' use. With the exception of the southeast quarter of section 6 this township is unfit for farming; nevertheless there are many good pieces of land which rank first class, but are interspersed with muskegs and rocks which render them inaccessible to settlers in summer time. I believe this township should be reserved for a timber limit.—*A. Bourgeault, D.L.S., 1908.*

Range 12.

16. The township is mostly wooded with poplar, spruce, birch, balsam and jackpine. The southwestern portion has been burned over and the soil as a whole is not of much value. Along Pinawa channel, when the timber has been taken off, there is land that would make good farms. No hay lands are found. The climate is similar to that at Winnipeg, but there are no high winds and the snowfall is much greater. The tramway being built by the corporation of the city of Winnipeg, from Lac du Bonnet village to Pointe du Bois, crosses Pinawa channel about three miles south of the south boundary of the township, and will, when completed, be an easy means of access to the township. There are no minerals, stone quarries or water-powers in this township. Game consisting of moose, deer, geese and ducks is plentiful.—*Geo. H. Watt, D.L.S., 1907.*

Range 13.

10. All the soil in this township is fourth class, about one-third being rocks and the remainder being spruce and tamarack swamps and muskegs with willow and small spruce and tamarack. The soil is therefore practically of no use for agricultural purposes. The whole of the township is covered with bush consisting principally of jackpine, spruce, tamarack and poplar from three to seven inches in diameter and willow, tamarack, spruce and jackpine scrub all equally distributed throughout the township. There is very little hay to be found but there are places if the country was drained which would produce some hay. All the water is fresh and can be had almost at any place without digging, where there are no rocks. There are a few small creeks to be found, all having good water. There are no lakes in this township neither waterfalls nor rapids from which any power could be developed. The climate is the general Manitoba climate, with no indications of summer frosts. Fuel is plentiful and can be had in almost any part of the township, and all through this district, consisting principally of spruce tamarack and jackpine. All the large timber has been cut. There are no stone quarries except rocks and boulders; neither are there coal or lignite veins nor minerals to be found. Moose and some deer are about the only game

Range 13—Continued.

to be found. The Grand Trunk Pacific railway runs through the southern part of the northern tier of sections. There are no trails except a few wood trails leading to Culver, a station on the Canadian Pacific railway about a mile north of the northeast corner of section 36.—*John Molloy, D.L.S., 1908.*

Range 14.

10. All the land, with the exception of three or four quarter sections in the northwest corner of the township is fourth class. About sixty per cent of the surface is high rock varying in height from ten to fifty feet and the remainder is spruce and tamarack swamps and muskegs, with spruce, tamarack and willow scrub. All of the surface is covered with bush, consisting of jackpine, tamarack, spruce and some poplar from three to eight inches in diameter and scrub and willow equally distributed throughout the township. There is very little hay to be had. Water can be had any place off the rocks without digging. There are a few small creeks and four or five lakes, all containing good water. Lake Brereton, a small portion of which is in section 36, is a large lake extending about four or five miles north and about two miles wide from east to west. The other lakes in the township are small, covering about seventy-five or one hundred acres each. Fish can be had in all these lakes, especially in lake Brereton, where they are very plentiful. There are no waterfalls or rapids from which power could be developed. The climate is the general Manitoba climate without any indication of summer frosts. Fuel, consisting of spruce, tamarack and jackpine can be had all through this district. There are no indications of coal or lignite veins. There are no stone quarries, all of the stone being granite or boulders. There are traces of gold to be found in this township, some of which is reported to have assayed three dollars to the ton. One mining claim has already been taken up near the northeast corner of section 28. Moose and black bear are very plentiful here, and wolves in the fall and winter. Geese and ducks are plentiful in the lakes in the spring and fall. The Canadian Pacific railway passes through the centre of the township. Rennie station is situated on section 24, where there is a postoffice and small store. The Grand Trunk Pacific railway passes through sections 36, 35, 34, 33, 28, 29 and 30, crossing the Canadian Pacific near the northeast corner of section 28. There are no trails except a few wood trails used in the winter to draw out cordwood.—*John Molloy, D.L.S., 1908.*

14. The township is reached by canoes from Kenora or Lac du Bonnet on the Winnipeg river. The soil is not generally good. The township is much broken by rough jackpine rocky ridges, some of them burned over and covered with deadfall, and spruce and tamarack muskegs. Some ties were taken out six or eight years ago and though occasional spruce remain they are not valuable. Some of the tamarack in the muskegs is large and suitable for piles. There is also much heavy sound poplar, tall and straight, growing within a mile of the river. Hay is to be found along the banks of Tie creek and is of fair quality. This creek is a large, wide stream, the water of which is good at all seasons of the year. It is used to a considerable extent by tourists who go by canoe down stream from Kenora to Lac du Bonnet, or even farther to Fort Alexander, thence by steamer to Selkirk and then by train to Winnipeg. Sturgeon falls may be used as a power site, and also the narrows in several places might be dammed and the power utilized. Whiteshell river is navigable for boats drawing two feet of water except for a small rapid full of boulders, about one quarter of a mile from its mouth. The rapid is quite submerged at the time of high water in the Winnipeg river. There were no summer frosts and but for the continued downfall of rain in July, August and September, we had fine weather. Rock everywhere is the same

Range 14—Continued.

pink granite and contains no minerals of economic value. Game consisting of moose, deer, caribou, bear, lynx and the smaller animals are found, and geese and ducks along the streams.—*Geo. H. Watt, D.L.S., 1907.*

15. (South outline.) This line runs mostly over a country composed of rocky ridges separated by muskegs or alder swamp. Near the Winnipeg river there is a strip of heavy poplar and balsam, but elsewhere the timber is mostly unfit for lumbering. The soil is mostly fourth class. There are no water-powers, stone quarries or minerals and no summer frosts were experienced. Game and fish are plentiful and the water is fresh and good.—*Geo. H. Watt, D.L.S., 1907.*

Range 15.

2. All the soil in this township would rank as third class, and the greater part of the township is swamp and muskeg with the exception of a few narrow ridges. None of the land would be fit for farming or grazing purposes. The whole of the surface is covered with bush, with the exception of a few quarter sections in the southwest corner, which are open muskeg and very wet. The bush consists principally of spruce and tamarack, varying in size from three to fifteen inches in diameter. There is a little poplar, jackpine and cedar to be found, but only in very narrow strips. There is no hay to be found except in sections 10, 11 and 12, along Reed river, a small stream varying in width from three to twelve feet. All the water is fresh and can be had almost anywhere on the surface. There are no water-powers available. Fuel can be had in unlimited quantities all through this section of country, consisting principally of spruce, tamarack and some poplar, cedar and jackpine. There are no stone quarries, coal or lignite veins or minerals of any kind to be found. Moose and black bear are the only kinds of game to be found. The moose are very plentiful. There are no roads or trails of any kind running through this township except a winter timber road which runs from Sprague and passes through sections 3, 10, 11 and 12. This is impassable except in winter. The town of Sprague is the nearest station; it is situated in township 1, range 14, where there is a store, station, postoffice and a number of settlers. The Canadian Northern railway passes through the southern part of township 1.—*John Molloy, D.L.S., 1907.*

3. The land in this township is all third or fourth class, consisting principally of spruce and tamarack swamps and muskeg. The soil is black loam or clay but is useless for farming or grazing purposes on account of it being so wet and covered with bush. Nearly all of the surface is covered with bush consisting principally of spruce and tamarack, varying in size from three to fifteen inches in diameter. There is a little poplar to be found averaging about five inches in diameter and considerable scrub and underbrush. The timber is equally distributed throughout the township. There are no hay meadows to be found. The water is all fresh, and can be had on the surface in almost any part of the township, at any time of the year. There are no streams of any kind. Fuel is very plentiful, and can be had all through this part of the country, principally spruce and tamarack, and small quantities of poplar, jackpine and cedar. There are no stone quarries, coal or lignite veins. Moose and black bear are the only kinds of game to be found. There are no trails leading into this township, and it is impossible to travel through this district with teams, except in the winter time. Sprague, situated in township 1, range 14, on the Canadian Northern railway, is the nearest village.—*John Molloy, D.L.S., 1907.*

4. Nearly all the soil in this township is fourth class and unfit for farming purposes. The surface is nearly all spruce and tamarack swamps and some large open

Range 15—Continued.

muskeg, which are mostly covered with water. The average diameter of the timber which is principally spruce and tamarack with a few poplar ridges would be about five or six inches. It is equally distributed throughout the township except in sections 2, 3, 9, 10, 11, 15 and 16 where there is a large open muskeg. There is no hay to be found in this township. All the water is fresh and can be found in almost any part of the township at any time of the year on the surface or by digging a few feet. The only stream to be found crosses the north boundary of section 31, a creek about twelve feet wide and two feet deep. There are no water-powers, stone quarries, coal or lignite veins to be found in this district. Fuel can be had in unlimited quantities all through this section of country, consisting principally of spruce and tamarack. Moose and black bear are the only kinds of game to be found. There are no trails passing through this township, and it is almost impossible to get into this section of country except in winter time.—*John Molloy, D.L.S., 1907.*

5. The land in this township is all fourth class and unfit for farming or grazing purposes, being made up principally of spruce and tamarack swamps, which generally are under water except in a very dry season. Nearly all of the township is covered with heavy bush, spruce and tamarack, averaging about eight inches in diameter, with some cedar, balsam, jackpine, poplar scrub and underbrush, equally distributed throughout the township. There is no hay in this township. The water is all first class and can be had at any time of the year either on the surface or by digging a few feet. There is a creek crossing the south boundary of section 6, about twelve feet wide and two feet deep. There are no water-powers available. Fuel is very plentiful all through this section of country, principally spruce and tamarack and some poplar and jackpine. There are no stone quarries, coal or lignite veins or minerals of any kind to be had. Moose and black bear are the only kinds of game to be found and are very plentiful. There are no trails or roads of any kind leading into this township.—*John Molloy, D.L.S., 1907.*

6. The land in this township in its present condition is useless, as it is almost completely covered with water from six inches to two feet deep. There is a large muskeg in the north and northeastern part of the township, which is impassable at any time of the year as it is a floating bog and dangerous for man or beast. The soil is all black and a good depth, but very wet and covered with spruce and tamarack swamps. With the exception of the large muskeg spoken of, the whole township is heavily timbered, mostly with spruce, tamarack and some cedar and poplar averaging about seven inches in diameter, and equally distributed throughout the township. All the water is first class and can be had in any part without digging at any time of the year. There are no water-powers to be found. Fuel is very plentiful all through this district, consisting principally of spruce and tamarack. There are no stone quarries, coal or lignite veins. Moose are about the only kind of game to be found and they are very plentiful. The Dawson trail running from Ste. Anne, a town on the Ontario division of the Canadian Northern railway, runs through the northern tier of sections, but it is impassable in this township, as it is mostly covered with water from one to two feet deep and it is altogether impassable across the Cariboo muskeg.—*John Molloy, D.L.S., 1907.*

7. The land in this township is useless for farming or grazing purposes, as it is all bush and covered with water in swamps and muskegs from six inches to two feet deep, except in places where there are large rocks which rise out of the muskeg, and a few ridges. The soil is nearly all a black loam and would be good farming land if there was any possible way of having it drained. Nearly all of the township is

heavily timbered with spruce, tamarack, cedar and some poplar, birch, balsam and jackpine. The average diameter of the timber is about seven inches, and is equally distributed throughout the township except in the southwest corner which is principally muskeg and floating bog with willow scrub and tamarack about four inches in diameter. All the water is first class and can be had any place in the township at any time of the year. Birch river, a stream averaging about fifteen feet wide and five feet deep passes through the northwest corner. Fuel consisting of spruce, tamarack and poplar, cedar, birch and pine can be had in unlimited quantities through this district. There are no stone quarries, but large boulders and ridges are quite numerous. There are no coal or lignite veins to be found. The climate is the general Manitoba climate. Moose and caribou are about the only kinds of game to be found. They are very plentiful through this district. The Dawson trail leading to Ste. Anne, a town on the Canadian Northern railway, passes through the northern part of the township to the south. There are no trails running through this township and it would be impossible to take a horse into it.—*John Molloy, D.L.S., 1907.*

8. There is scarcely any arable land in this township, as it consists principally of swamps and rocks. All the swamps contain water from six inches to one and one-half feet deep. The soil is nearly all a black loam. All the township is heavily timbered with spruce, tamarack and cedar, and some spots with jackpine, birch and poplar, where there are rocks. All the timber varies in diameter from five inches to two feet, and it is equally distributed throughout the township. All the water is first class and can be had any place in the township at any time of the year without digging. Birch river, a stream about fifty feet wide and from five to seven feet deep runs through the southwest corner. Fuel is very plentiful all through this part of the country, consisting principally of spruce and tamarack. There are no stone quarries, coal or lignite veins or water-powers to be found in this township. The climate is the general Manitoba climate. Moose and caribou are about the only kind of game to be found. They are very plentiful all through this district. There are no trails of any kind leading into this township, and it would be impossible to get a horse within six or eight miles of any part of the township.—*John Molloy, D.L.S., 1907.*

10. The land in this township is useless for farming or grazing purposes as three-quarters of the surface is covered with rock and the remainder is spruce and tamarack swamps. The rocks are from twenty-five to sixty feet high. All the township is covered with bush consisting of jackpine, spruce and tamarack from three to eight inches in diameter and scrub, all equally distributed through the township. There is no hay to be found in this township. Water is very plentiful in the swamps at any time of the year. There are a number of creeks and seven or eight good sized lakes containing good water. There are no falls or rapids from which any power could be developed. The climate is the general Manitoba climate with no indication of summer frosts. Fuel is very plentiful all through this section of country, consisting of spruce, tamarack, jackpine and some poplar, although all the large timber has been cut. There are no indications of coal or lignite veins neither are there stone quarries except granite and boulders. Moose, black bear and wolves are very plentiful. Geese and ducks are plentiful for a time in the spring and fall. The Canadian Pacific railway runs through the centre of the township. Telford station is about a mile east and Rennie about a mile west of the township lines. The Grand Trunk Pacific railway passes along the north boundary. There are no roads except a few winter trails used for drawing wood.—*John Molloy, D.L.S., 1908.*

TOWNSHIPS EAST OF THE PRINCIPAL MERIDIAN.

Range 15—Continued.

12. (Part north outline). This line crosses Whiteshell river, a stream about one chain and a half wide, twice within thirty chains. The country here is level and covered with alder and willow. Near the middle of the north boundary of section 35 the country changes, becoming very rough and rocky. The ridges are covered with pitch-pine while the depressions are filled with spruce, poplar, birch, tamarack and balsam, which continue to the northeast corner of the township. The soil is third class.—*B. J. Saunders, D.L.S., 1908.*

Range 16.

12. (North outline). This line commences in heavy spruce, balsam, poplar, tamarack and birch, and in the north boundary of section 31 runs for thirty chains in Whiteshell river. This stream comes through One Island lake which lies to the south of the line at this point. It forms the drainage channel of Whiteshell, Little Whiteshell and Cross lake and its tributary waters. Throughout the rest of its length the line runs through a rolling, rocky country covered with pitch-pine, birch, balsam, spruce, poplar and tamarack, while a few ash occur on the north boundary of section 34. Whiteshell river is again crossed on the north boundary of section 34. To the south of the line the river widens out into Little Whiteshell lake. The soil varies from third to fourth class.—*B. J. Saunders, D.L.S., 1908.*

Range 17.

12. (North outline). This line runs through a rough rocky country covered with pitch-pine, spruce, birch and poplar. A few stretches of tamarack and spruce swamp occur, usually near the lakes, several of which lie close to the line. A lake lies near the line north of section 31; two lakes, one north the other south of the line, lie along the north boundary of section 32, while a large lake to the north, parallels the line through sections 33, 34, 35, and is intersected by the line in these sections. The line intersects the Ontario-Manitoba boundary thirty-one chains east of the northeast corner of section 35, five chains south of the forty-fifth mile post.—*B. J. Saunders, D.L.S., 1908.*

TOWNSHIPS WEST OF THE PRINCIPAL MERIDIAN.

Range 1.

24. This township is situated about thirty miles in a northwesterly direction from Hnausa postoffice on the west shore of lake Winnipeg and may be most easily approached by means of Icelandic river road by way of Framnes and Vidir, the latter place being the nearest postoffice. The character of the soil in the northerly and easterly sections of this township is extremely rocky, in many places the bare limestone rock appearing at the surface and in other places being only covered by a few inches of light gravelly soil. The southwesterly portion of the township is largely composed of muskeg and hay sloughs, which at the time of our survey were flooded with water from the incessant rains. The only good land in the township is situated near the northwest corner, adjoining the east branch of Fisher river, which passes through sections 30. 31 and 32. The northerly and easterly portions of this township are comparatively high and dry. The southerly and westerly portions are somewhat lower with a drainage to the northwest. The east branch of Fisher river, which passes through sections 30, 31 and 32, has an average depth below the general surface of about fifteen feet and thus affords good drainage for the adjoining

lands. This township like others in the vicinity has been swept by fire at some time during the past few years and consequently no timber of any value was found. The general character of the surface may be described as 'brulé,' containing a few large, dead, standing stubs and many fallen trees. The growing timber is all very small, from one to three inches in diameter and consists of white and black poplar, scrub spruce, tamarack and willow. A very large amount of natural hay is to be found in the westerly sections of this township, although at the time of my survey it was so inundated as to be inaccessible for cutting. During an average season, however, a very large amount of hay would be available, notably upon sections 9, 10, 15, 16, 21, 17, 18 and 19.

Besides the large amount of water occupying the hay lands in the western portion of this township, the east branch of Fisher river, already referred to, flows in a northerly direction through sections 30, 31 and 32, and is a fine, fresh water stream about fifty feet in width and eight feet deep in places; its average depth, however, is about three feet and the current about two miles an hour. A small fresh water creek also occurs on section 13. No water-power occurs upon this township. Judging from the growth of vegetation in this locality I would say that the climate is quite favourable for the pursuit of general farming. No summer frosts were experienced, and during the past season the weather was extremely wet and productive of great growth. Occasionally the summer temperatures are exceedingly warm, although somewhat tempered by cool breezes either from lake Winnipeg or lake Manitoba. During the winter season the weather is usually fine and cold, forty degrees below zero being about the lowest temperature recorded during the past winter. The fuel supply of this township is limited to the standing dead or fallen timber, which is not too abundant in any portion of the township. The eastern portion of this township being chiefly composed of limestone rock, much of which appears quite bare on the surface, may afford a serviceable quantity of building stone if opened up. On the surface, however, it appears to be of a very shaly and highly weathered variety. No minerals of economic value occur upon this township. Small game such as prairie-chickens and ruffed grouse were occasionally met with in this locality, but the only species of game found of any consequence is the moose, which is comparatively common throughout the district.—*J. W. Tyrrell, D.L.S., 1907.*

25. This township may be most easily approached by means of a wagon road from Hnausa and Vidir, the distance from Hnausa being about forty miles. It may also be reached by means of a fairly good wagon road from Fisher River mission, the distance from that place being about twenty-five miles. Vidir is the next postoffice. The soil in this township may be graded generally as second and third classes, the better sections occupying the northwest and the northeast corners of the township, where the land is fairly good for farming purposes. In the southwest, sections 6 and 7 are largely occupied by limestone ridges, while the same description applies to sections 2, 3, 4, 10 and 11. Another prominent limestone ridge occupies portions of sections 21, 22, 27, 28 and 34. The surface of this township is somewhat broken by several limestone ridges and the passage of Fisher river through the township from south to north, but otherwise the land may be described as gently rolling. The surface is chiefly covered with poplar and willow scrub and brulé. The township having been swept by fire several years ago. As above intimated, no timber of any consequence is found upon this township, whatever may have existed having been destroyed by a forest fire with the exception of a few trees along the river valley, where they were protected from the fire. No natural hay was found within the area of this township, the nearest local supply being in the next township to the north, from where two settlers living upon sections 26 and 27 obtained their supply. This town-

TOWNSHIPS WEST OF THE PRINCIPAL MERIDIAN.

Range 1—Continued.

ship is exceptionally well watered by the east branch of Fisher river and several small tributary streams. Fisher river passes though sections 5, 9, 16, 15, 22, 27, 34 and 33, while branches of the same pass through sections 11, 12, 13, 14, 23, 24, 26, 27, 35, and also through sections 20, 29. 30, 31 and 32. The water of these streams is of good quality and well suited for domestic use. Besides these streams no water is found upon the township except on the north boundaries of sections 31 and 32 which are just touched by the west branch of Fisher river. Little or no surface water occurs upon this township. In section 22 a rapid occurs on Fisher river which would afford a limited amount of water-power, the fall of the stream being about ten feet in one hundred yards. The climate of this township is similar to that of the other eastern parts of Manitoba though probably somewhat more moist on account of the proximity of the great lakes both to the east and west. Hard frost sets in about the middle of November sufficient to freeze the swamps and smaller lakes. Snow usually follows within a week or two. The climate seems to be quite favourable to the successful growing of oats, barley, wheat and all the ordinary root crops, for they were successfully grown during this summer, both in this township and at the Fisher River mission station. An abundant supply of fuel in the shape of dead wood is found in this township, though much of it is now soggy and falling to decay. The new forest growth however is already replacing that which was destroyed by fire and is large enough to give an ample local supply of fuel. No coal or other form of fuel is known to occur in the township. The rock formation being limestone which outcrops at the surface in many places, there is probably any amount of building stone upon this township, though as yet no quarries have been opened up. The most important variety of game known in the vicinity of this township is the moose which is comparatively abundant. Elk or wapiti are also found and black bears are not uncommon. Timber wolves are reported to exist, though no signs of them were observed. Of feathered game the supply is very limited, being confined to a few ruffed grouse, spruce partridges, prairie-chickens and ducks, the last named being very scarce.—*J. W. Tyrrell, D.L.S., 1908.*

26. This township is accessible by means of a wagon road from Hnausa and Vidir, the distance from Hnausa being about forty-five miles. It is also accessible by wagon road from the Fisher River mission station from which place it is distant only about fifteen miles. It may also be reached from the latter place by means of small boats or canoes, following Fisher river, although because of numerous small rapids occurring in this river, the wagon road is the preferable route for heavy freight. The soil of this township may be considered as first and second class, the depth of black loam being in many places eight, twelve and even as much as eighteen inches, having as a rule clay subsoil. The greater part of this township is well suited for general agricultural purposes. The surface of this township is considerably broken by both east and west branches of Fisher river, but otherwise it may be generally described as gently rolling country, much of which is brulé, other sections being covered by poplar and willow scrub. Several extensive muskegs occur within this township and occupy portions of sections 1, 4, 5, 10, 11, 12, 13, 14, 15, 22, 23, 24, 26, 27, 28, 29, 30, 31, 32, 33, 34 and 35. Rocky limestone ridges of about thirty feet in height occur upon sections 25, 35 and 36 extending in a northerly and southerly general direction. No timber of any value is found upon this township, the original forest having been destroyed by forest fires some years ago. This township is well supplied with a good quality of marsh hay. The chief localities noted are as follows: sections 3, 4, 7, 8, 13, 14, 15, 16, 17, 20, 21, 22, 23; 24; 25; 26; 28, 29, 33, 35 and 36. The western part of this township is well supplied with good water from two branches of Fisher river which pass in a northerly direction through sections 4, 5, 6, 8, 9, 16, 17, 18, 19, 20, 29, 30, 31 and 32. A small tributary of the east branch of this river also passes through sec-

tions 2, 10, 9 and 16. Other small streams occur upon sections 8 and 9 as well as upon sections 18 and 19. Besides these streams a large amount of surface water exists in the muskegs in several sections of the township and more particularly in the north-west corner. Although a number of small rapids occur at various points on both branches of Fisher river, none are of sufficient fall to afford any considerable amount of water-power. The climate of the locality of this township is similar to that of the other eastern parts of Manitoba though probably somewhat more moist because of the proximity of the great lakes both to the east and the west. Hard frost sets in about the middle of November sufficient to freeze the swamps and smaller lakes. Snow usually follows within a week or two. The climate seems to be quite favourable to the successful growing of oats, barley, wheat and all the ordinary root crops, for these were successfully grown during the past summer both in township 25, range 1 and at Fisher River mission station. An abundant supply of fuel in the shape of dead wood is found upon this township, though much of this is now soggy and falling to decay. The new forest growth, however, is now already replacing that which was destroyed by fire, and is already large enough to give an ample local supply of fuel. No coal or other kind of fuel is known to occur upon this township. The rock formation being limestone, which outcrops at the surface in a few places, there is probably a considerable amount of building stone upon this township, though as yet no quarries have been opened up. No minerals of economic value are known to exist upon this township. The most important variety of game known in the vicinity of this township is the moose which is comparatively abundant. Elk or wapiti are also found and black bears are not uncommon. Timber wolves are reported to exist, though no signs of them were observed. Of feathered game the supply is rather limited, being confined to a few ruffed grouse, spruce partridges, prairie-chickens and ducks, the last named being very scarce.—*J. W. Tyrrell, D.L.S., 1908.*

27. This township is most easily accessible by means of a wagon road from the mission station at Fisher river from which place it is distant only about ten miles. It may also be conveniently reached in small boats or canoes by means of Fisher river which passes completely through the township from southwest to northeast. It may also be reached from Hnausa and Vidir by means of a fairly good wagon road, but is distant from Hnausa about fifty miles. The soil of the central and eastern portions of this township varies from first to second class possessing from six to eighteen inches of black loam upon clay subsoil and is well suited for general agricultural purposes, but the western part of the township as well as the northeasterly corner are exceedingly wet, being composed chiefly of muskeg. The surface of this township varies from level to gently rolling except at the southeast corner, where limestone ridges make their appearance. Nearly half the surface of this township is occupied by muskegs, but the remainder is covered chiefly by poplar scrub and brulé. A very limited amount of live timber exists along the valley of Fisher river, but otherwise none occurs upon this township, the original forest having been destroyed by fire some years ago. A large amount of good marsh hay occurs in this township on sections 13, 14, 15, 16, 22, 23, 24, 25, 26, 27, 33 and 34. This township is abundantly supplied with fresh water both from the main stream of Fisher river which passes through sections 18, 17, 20, 21, 22, 27, 34, 35 and also from the extensive muskegs occupying almost the whole of the western part of the township as well as the northeast corner. A number of small rapids occur upon Fisher river in its course through the township, the fall of which was estimated to be from three to five feet so that none of these rapids are sufficient to afford any considerable amount of water-power. The climate of the locality is similar to that of the other eastern parts of Manitoba, though probably somewhat more moist on account of the proximity of the great lakes both to the east and

Range 1—Continued.

west. Hard frost sets in about the middle of November sufficient to freeze the swamps and smaller lakes. Snow usually follows within a week or two. The climate seems to be quite favourable to the successful growing of oats, barley, wheat and all the ordinary root crops, for these were successfully grown both in township 25, range 1 and at Fisher River mission station. An abundant supply of fuel in the form of dead wood is found upon this township, though much of it is now soggy and falling to decay. The new forest growth, however, is now replacing that which was destroyed by fire, and is already large enough to give an ample local supply of fuel. No coal or other kind of fuel is known to occur upon this township. The rock formation being limestone, which outcrops in a few places, there is probably a considerable amount of building stone upon this township, though as yet no quarries have been opened up. No minerals of economic value are known to exist upon this township. The most important variety of game known in the vicinity is the moose which is comparatively abundant. Elk or wapiti are also found and black bears are not uncommon. Timber wolves are reported to exist, though no signs of them were observed. Of feathered game the supply is rather limited, being confined to a few ruffed grouse, spruce partridges, prairie-chickens and ducks, the last named being very scarce.—*J. W. Tyrrell, D.L.S., 1908.*

28. This township adjoins Fisher River Indian reserve to the west and may be most easily reached from the mission station at Fisher river by means of a wagon road, but also by means of small boats or canoes on the river which passes through the township. The soil of the eastern half of this township varies from first to second class and is well suited for general agricultural purposes, but the western half of the township is exceedingly wet and largely composed of muskeg. The surface of this township varies from gently rolling to level; the western half of it however is occupied by an immense stretch of muskeg containing wide stretches of open water. The eastern part of the township is chiefly covered by young poplar and willow scrub, but along the banks of the river some large poplar and spruce occur. A small amount of large timber consisting of spruce and poplar from eight to eighteen inches in diameter is found along the banks of Fisher river, more especially upon sections 13, 14, 23 and 24. A large amount of fine marsh hay occurs upon this township chiefly upon sections 1, 2, 10, 11, 14, 15, 16, 21, 22, 23, 24, 25, 26 and 27. The southeastern portion of this township is well watered by the main stream of Fisher river which passes through sections 2, 11, 14, 13 and 24 while a small tributary of Fisher river which passes through sections 16, 22, 23, 21 and 14 supplies the central part of the township with excellent water. The western half of the township contains an abundance of surface water in the extensive muskegs which largely cover it. Although several small rapids occur upon Fisher river in this township, none of them are of sufficient fall to afford any considerable amount of water-power. The climate of the locality of this township is similar to that of the other eastern parts of Manitoba, though probably somewhat more moist on account of the proximity of the great lakes both to the east and the west. Hard frosts sets in about the middle of November, sufficient to freeze the swamps and smaller lakes. Snow usually follows within a week or two. The climate seems to be quite favourable to the successful growing of oats, barley, wheat and all the ordinary root crops, for these were successfully grown last summer, both in township 25, range 1 and at Fisher River mission station. An abundant supply of fuel in the shape of dead wood is found upon the township, though much of this is now soggy and falling to decay. The new forest growth, however, is replacing that which was destroyed by fire, and is already large enough to give an ample local supply of fuel. No coal or other kind of fuel is known to exist in the township. The rock

Range 1—Continued.

formation being limestone which outcrops at the surface in several places, there is probably quite an amount of building stone upon the township, though as yet no quarries have been opened up. No minerals of economic value are known to exist upon the township. The most important variety of game known in the vicinity of the township is the moose which is comparatively abundant. Elk, or wapiti are also found and black bears are not uncommon. Timber wolves are reported to exist, though no signs of them were observed. Of feathered game the supply is very limited, being confined to a few ruffed grouse, spruce partridges, prairie-chickens and ducks, the last named being very scarce.—*J. W. Tyrrell, D.L.S., 1908.*

Range 2.

24. This township is situated in a northeasterly direction and about thirty-six miles distant from Hnausa postoffice, on the shore of lake Winnipeg and may be most easily approached by means of Icelandic river road by way of Framnes and Vidir, which latter is the nearest existing postoffice. The character of the soil in the more easterly portion of this township, particularly along the valley of Fisher river, is that of a black sandy loam with clay subsoil, while farther west the limestone rock again makes its appearance and is in many places but sparingly covered by light sandy clay and gravel. Along the valley of Fisher river, which passes through sections 3, 10, 15, 14, 13, 24 and 25, the soil may be described as first class and well suited for agricultural purposes. The surface of this township is nearly level with slight drainage toward the east and northeast. Through the northwest section runs a limestone ridge and the southwest portion is swampy. No growing timber of any consequence was found upon this township, the whole surface having been burnt over not long since. The country may consequently be generally described by the term brulé, in which some tall standing stubs occur and many fallen trees. The growing wood which is chiefly white and black poplar is very small, from one to three inches in diameter. A large quantity of marsh hay occurs upon this township, particularly in some of the northeasterly sections adjoining Fisher river. A considerable amount of hay is also found on sections 2, 3, 10 and 11 as well as on several of the most westerly sections of the township. Besides a large amount of surface water, which is found in the hay marshes throughout the various sections of the township, the southeasterly and easterly part of the township is well watered by Fisher river, a fine fresh water stream of about fifty feet in width and an average of three feet in depth. No water-power is known to occur upon this township.

Judging from the growth of vegetation noted in this locality I would say that the climate is quite favourable for the pursuit of general agriculture. No summer frosts were experienced and during the past season the weather was extremely wet and productive of great growth. Occasionally the summer temperatures are exceedingly warm, although somewhat tempered by cool breezes either from lake Winnipeg or lake Manitoba. During the winter season the weather is usually fine and cold; forty degrees below zero being about the lowest temperature recorded during the past winter. The fuel supply of this township is mostly limited to the standing dead or fallen timber, which is none too abundant in the western portion of the township, although the eastern sections are fairly well supplied. No stone quarries have been opened upon this township, but as the formation is that of limestone, although much weathered or broken on the surface, it is quite possible that if opened up to any considerable depth a serviceable quality of building stone might be obtained. Other than the limestone, no minerals of economic value are known to occur in this township. Small game such as prairie-chickens and ruffed grouse were occasionally met with in this locality,

Range 2—Continued.

but the only species of game found of any consequence is the moose, which is comparatively common throughout the district.—*J. W. Tyrrell, D.L.S., 1908.*

25. This township may be reached by a wagon road either from Hnausa and Vidir or from Fisher River mission, the distance from the latter place being about twenty-five miles and that from Hnausa about forty-five. It may also be reached by means of small boats or canoes on Fisher river, but as numerous rapids occur upon this stream the wagon roads are preferable for heavy freight. Vidir is the most convenient post-office, mails reaching there twice a week. In the west and north portions of this township the soil is chiefly first class, averaging eight inches of black loam upon clay subsoil, and is well suited for general farming purposes but in the south and east the soil is more shallow and rocky with only from two to six inches of loam upon limestone rock or gravel. This township is chiefly covered with poplar and willow scrub, but considerable tamarack is found in the marshy lands, and jackpine upon the rocky ridges, of which there are several in the various sections of the township. The surface generally is, however, comparatively level, the ridges ranging from fifteen to fifty feet in height. Little timber of any value is found upon the township, the country having been swept by fire some eighteen or twenty years ago. A few large tamarack occur upon sections 16, 21, 30, and 31, and spruce upon sections 3, 4, 18, 19, 30 and 31, but not in sufficient quantities to be of any commercial value. An abundance of marsh or slough hay occurs in various parts of this township, notably upon sections 9, 12, 13, 14, 15, 16, 21, 22, 25, 28, 29, 33, 34, 35, and 36. This township is well supplied with good fresh water by the west branch of Fisher river and some of its smaller tributary streams. The river passes through sections 7, 17, 18, 20, 29, 28, 33 and 34 and small branch streams pass through sections 7 and 32. A large wet slough occurs upon parts of sections 11, 12, 13 and 14, also affording a local water supply. The average width of Fisher river through this township is about one chain, the depth is about three feet and estimated rate of current two miles per hour. The rock formation of the country being limestone the water of both sloughs and streams is hard but good for drinking purposes. Though some small rapids occur upon Fisher river, none are of sufficient fall to furnish any considerable amount of water-power. The climate of the locality of this township is similar to that of other eastern parts of Manitoba though probably somewhat more moist because of the proximity of the great lakes both to the east and west. Hard frost sets in about the middle of November, sufficient to freeze the swamps and smaller lakes, and snow usually follows within a week or two, though sometimes earlier. The climate is not unsuited for the successful growing of oats, barley, wheat, and all the ordinary root crops, for these were successfully grown during the past summer both upon township 25, range 1 and at Fisher River mission. An abundant fuel supply in the shape of dead wood is found upon this township, although much of this is now soggy and falling to decay. The young new forest growth is however already replacing that which was destroyed by fire and is even now large enough to afford an ample local supply of fuel. No other form of fuel is known to occur in the township. The rock formation being limestone, which outcrops at the surface in many places, there is likely to be any amount of building stone upon this township, though as yet no quarries have been opened up No minerals of economic value are known to exist upon this township. The most important variety of game found on this township is the moose which is comparatively abundant. Elk, or wapiti are also found and black bears are not uncommon. Timber wolves are reported to exist, though no signs of them were observed. Of feathered game the supply is very limited, being confined to a few ruffed grouse, spruce partridges, prairie-chickens and ducks, the last named being very scarce.—*J. W. Tyrrell, D.L.S., 1908.*

Range 2—Continued.

26. This township may be reached by wagon road either from Hnausa and Vidir, or from Fisher River mission station on the south side of Fisher bay on lake Winnipeg, but it is much nearer the latter place, the distance from Fisher bay being only about twenty miles, whereas the distance to Hnausa is at least twice as great. It may also be reached by means of canoes and small boats following Fisher river, which passes through sections 1, 2, 3, 11 and 12 of this township. On account of the occurrence of numerous rapids upon this river, however, the wagon road is the more preferable route for the transportation of heavy feight. The soil of this township is composed chiefly of black loam on the surface which varies in depth from about four to eight inches and in most cases this is underlain by clay substrata which in some places contains gravel and boulders. In sections 13, 14, 23 and 24 there is a large outcropping of limestone rock, barely covered in many places with a thin coating of soil. The general character of the surface of this township is that of a gently rolling country, but limestone ridges of about twenty feet in height occur upon sections 13, 14, 23 and 24 as well as upon sections 31 and 34. A large percentage of the surface of this township is composed of wet muskegs with open water in some places. Between these muskegs the land is as a rule covered with scrub and brulé. No large live timber now exists in this township, most of it having been cut some years ago, what remained having been destroyed subsequently by forest fires. A very considerable amount of hay occurs in this township, the best localities being sections 14, 23, 24, 27, 28, 33 and 34, a good quality of marsh hay being found on these sections. More or less marsh hay of a coarser quality exists upon many sections about the shores of the muskegs which are very prevalent. This township is well supplied with good fresh water from the west branch of Fisher river and several small tributary streams as well as by the large amount of surface water in the numerous muskegs. Fisher river passes through sections 1, 2, 3, 4, 11 and 12, while sections 5, 6, 24, 25, 26 and 35 are watered by smaller streams. Surface water from the muskegs can be obtained upon almost every section. No water-power exists in this township. The climate of the locality is similar to that of the other eastern parts of Manitoba though probably somewhat more moist because of the proximity of the great lakes both to the east and west. Hard frost sets in about the middle of November, sufficient to freeze the swamps and smaller lakes. Snow usually follows within a week or two. The climate seems to be quite favourable to the successful growing of oats, barley, wheat and all the ordinary root crops, for these were successfully grown during the past summer both in township 25, range 1 and at the Fisher River mission station. An abundant supply of fuel in the shape of dead wood is found upon this township, though much of this is now soggy and falling to decay. The new forest growth, however, is already replacing that which was destroyed by fire and is large enough to give an ample local supply of fuel. No coal or other form of fuel is known to occur in the township. The rock formation is limestone which outcrops in several places; there is probably any amount of building stone upon the township, though as yet no quarries have been opened up. No minerals of economic value are known to exist upon this township. The most important variety of game known in the vicinity is the moose which is comparatively abundant. Elk or wapiti are also found and black bears are not uncommon. Timber wolves are reported to exist, though no signs of them were observed. Of feathered game the supply is very limited, being confined to a few ruffed grouse, spruce partridges, prairie-chickens and ducks, the last named being very scarce.—*J. W. Tyrrell, D.L.S., 1908.*

27. This township may be most easily approached from Fisher River mission station either by means of small boats or canoes upon Fisher river or by use of wagons on a road which is bad under the most favourable conditions. The distance to this town-

Range 2—Continued.

ship from Fisher River mission is about fifteen miles. It may also be reached by wagon road from Hnausa and Vidir; this road is fairly good, but the distance to be covered is very much greater, being about fifty-five miles. The soil of this township may be considered as second and third class, the best of it having not more than six inches of black loam upon a clay subsoil, but much of it is only from three to four inches in depth upon gravel or bed rock. More than one-third of the whole area of this township is covered by muskegs, so wet as to render them unfit for use. The general character of the surface of this township may be described as gently rolling with occasional rocky ridges, intercepted by extensive muskegs. With the exception of these the greater part of the surface is covered with poplar scrub. Upon sections 7, 18, 19, 20, 29, 31 and 33 there is a considerable amount of large timber, consisting chiefly of spruce and poplar ranging from four to eighteen inches in diameter. There is also some jackpine ranging from eight to twelve inches in diameter. Although more than one-third of the surface of this township is occupied by muskegs they are as a rule too soft and wet for the production of hay, but a considerable amount of good marsh hay was found upon sections 9, 16, 24, 32, 33 and 35. Although this township is adjacent to Fisher river, only a small branch of that stream passes through any portion of it. This stream flows through sections 14 and 11, discharging the waters of a large muskeg covering the central and southeastern part of the township. Abundance of surface water, however, exists in almost every section of the township and is of a sufficiently good quality for domestic purposes. No water-power exists in this township. The climate of the locality is similar to that of the other eastern parts of Manitoba, though probably somewhat more moist on account of the proximity of the great lakes both to the east and west. Hard frost sets in about the middle of November, sufficient to freeze the swamps and smaller lakes. Snow usually follows within a week or two. The climate seems to be quite favourable for the successful growing of oats, barley, wheat and all the ordinary root crops, for these were successfully grown during the past summer both in township 25, range 1 and at Fisher River mission station. An abundant supply of fuel in the shape of dead wood is found upon this township, though much of it is now soggy and falling to decay. The new forest growth however is now already replacing that which was destroyed by fire and is large enough to give an ample local supply of fuel. No coal or other kind of fuel is known to occur in the township. The rock formation being limestone which outcrops at the surface in several places, there is probably any amount of building stone upon the township, though as yet no quarries have been opened up. No minerals of economic value are known to exist upon the township. The most important variety of game known in the vicinity is the moose, which is comparatively abundant. Elk, or wapiti, are also found and black bears are not uncommon. Timber wolves are reported to exist, though no signs of them were observed. Of feathered game the supply is very limited, being confined to a few ruffed grouse, spruce partridges, prairie-chickens and ducks, the last named being very scarce.—*J. W. Tyrrell, D.L.S., 1908.*

Range 3.

24. This township is situated in a northwesterly direction about forty-five miles distant from Hnausa postoffice, on the west shore of lake Winnipeg. It is perhaps most easily approached by means of Icelandic river road, by way of Framnes and Vidir, which latter place is the nearest postoffice. The general character of the soil of this township is that of a sandy clay subsoil and appears to be well suited for general farming purposes. The surface of this township is almost level, with a slight fall toward the northeast, and is comparatively well wooded. This township is

much better timbered than most others in this vicinity, as the bush fires had evidently been intercepted by Fisher river. Immediately west of the river, and approximately parallel with it there is a very considerable amount of fine spruce timber, many of the trees running from ten to twenty-four inches in diameter. This timber may be said to occur chiefly upon sections 26, 35 and 34, although scattered bluffs of considerable size were also observed upon sections 21, 28 and 29 and more or less in small quantities throughout the other portions of the township. This township contains a fair amount of marsh hay scattered throughout the various sections, the chief localities noted being upon sections 15, 16, 19, 21, 22, 24, 25, 29 and 30 although several small hay sloughs occur in various other sections of the township. In addition to the surface water found in the numerous hay marshes above referred to, the west branch of Fisher river flows in a northeasterly direction through sections 15, 23, 24, 25, 36 and 35, apparently having its source in an extensive marsh in section 15. Fisher river is a fine fresh water stream thirty feet in width, three feet deep and has a current of two miles an hour. No water-power occurs in this township. Judging from the growth of vegetation noted in this locality, I would say that the climate is very favourable for the pursuit of general farming. No summer frosts were experienced and during the past season the weather was extremely wet and productive of great growth. Occasionally the summer temperatures are exceedingly warm, although somewhat tempered by cool breezes either from lake Winnipeg or lake Manitoba. During the winter season the weather is usually fine and cold, forty degrees below zero being about the lowest temperature recorded during the past winter. This township is more abundantly supplied with fuel, in the shape of growing timber, than most others in the vicinity, since it has not been so completely swept by fire as most others of the surrounding localities. In addition to the spruce already referred to under the head of timber, a large quantity of poplar and birch is also found growing throughout the various sections of the township, sufficient to provide an abundant supply of fuel for many years to come. No stone quarries have been opened upon the township, but as the formation is that of limestone, although much weathered and broken on the surface, it is quite possible that if opened up to any considerable depth, a serviceable quality of building stone might be obtained. Other than the limestone, no minerals of economic value are known to occur in this township. Small game, such as prairie-chickens and ruffed grouse, were occasionally met with in this locality, but the only species of game found of any consequence is the moose, which is comparatively common throughout the district.—*J. W. Tyrrell, D.L.S., 1908.*

25. This township can be most easily reached by a trail from Teulon, which enters the township in section 1 and ends in section 32. The soil is a black or sandy loam with a clay subsoil, except on the ridges which are usually gravelly or stony. There is some good farming land. The land is gently rolling and covered with heavy timber except in the southeast part which is covered with scrub. The west half of the township is covered with heavy bush. The ridges are covered with jackpine, spruce and poplar which run from about four inches to sixteen or eighteen inches in diameter, while the lower ground is covered with spruce or tamarack of about the same size. The northeast portion of the township is covered with poplar of about four inches to twelve inches, and some scattered spruce and jackpine. The southeast portion of the township is covered with small poplar, jackpine and willow with a few scattered clumps of spruce. Some good hay could be cut around the slough on sections 15 and 16, but most of the sloughs do not produce good hay. There is an abundance of good water in all the sloughs. Fisher river, which crosses the southeast part of the township is a

Range 3—Continued.

rather sluggish stream, about one chain wide, which narrows down to about twenty-five links where there are rapids. It is not a good stream for water-power as at the time of the survey (November) there was very little water in it. There were several places where there is considerable fall and some power could be developed by damming the stream. There is plenty of dry timber everywhere for fuel, but there are no stone quarries nor minerals of economic value. Moose, elk, deer and bear are plentiful. There are a few partridges and prairie-chickens and some foxes and coyotes. Fish are found in Fisher river.—*Chas. M. Teasdale, D.L.S., 1908.*

Range 4.

25. This township can be most easily reached by a trail from Teulon which enters township 25, range 3. I opened up a trail easterly across townhips 25, ranges 4 and 3, which joins this trail in section 14. The soil consists of about six inches of loam but has a gravelly or stony subsoil in most parts and would be very hard land to clear on account of the timber. The surface is mostly level but is gently rolling in some parts. The whole township is covered with heavy bush consisting of spruce, tamarack, jack-pine and poplar. Most of the timber would run between eight and sixteen inches, but in some parts it is larger, and is best adapted for making railway ties. Some hay could be cut around Little Birch and Sleeve lakes. The sloughs in the remainder of the township do not produce hay but they supply permanent fresh water. There are no streams and so no available water-power. Frosts were quite common after August 18. Dry wood is scarce and there are no coal or lignite veins in the township. There are no stone quarries or minerals of economic value. Moose, elk and bear are plentiful. There are a few partridges. Ducks were plentiful, while good fish are found in both Birch and Sleeve lakes.—*Chas. M. Teasdale, D.L.S., 1908.*

Range 5.

24. This township is situated about twelve miles due east of Dog lake, or about twenty miles northeast of Dog Creek Indian reserve. It is doubtless most easily reached from some point on the east shore of lake Manitoba, although it was reached by me by means of a trail cut from the east. The soil of this township is composed chiefly of loam with clay and in some places gravel subsoil. The surface of this township is fairly level and well wooded, but contains a very large percentage of swamp land. In the southern part of the township there is situated a large fresh-water lake which possesses a very swampy, ill-defined shore line. This township contains a considerable amount of growing timber; the most valuable of which is chiefly spruce and tamarack and occupies the northeasterly part of the township, being confined chiefly to sections 24.25, 36, 35 and 34. The northwesterly part of the township is chiefly brulé, whilst the central, westerly and southern portions are chiefly composed of swamp lands. This township contains a large percentage of swamp land, but during the past season when the survey was being made, the country was so exceedingly wet that what might, during average seasons, be good hay land, was found to be flooded. In several localities hay was noted, some of them being upon sections 1, 2, 3, 9, 15, 16, 28, 33 and 35. This township is most abundantly supplied with water not only in the numerous marsh lands, but also by means of a large body of water named Stewart lake, occupying portions of sections 2, 3, 9, 10, 11, 15 and 16, and also by a portion of Sleeve lake which occupies the northeasterly part of sections 25 and 36. Both of these lakes are fresh water and it is said that in Sleeve lake abundance of fish of various kinds may be caught. No water-power is known to exist upon this

township. Judging from the growth of vegetation noted in this locality, I would say that the climate is quite favourable for the pursuit of general agriculture. No summer frosts were experienced and during the past season the weather was extremely wet and productive of great growth. Occasionally the summer temperatures are exceedingly warm, although somewhat tempered by cool breezes either from lake Winnipeg or lake Manitoba. During the winter season the weather is usually fine and cold. Forty degrees below zero was about the lowest temperature recorded during the past winter. In the growing timber this township possesses an abundant supply of fuel for local use. In the brulé sections of the township there is also a large amount of standing dead timber as well as fallen wood, which affords an excellent supply for immediate use. No stone quarries nor minerals of economic value occur upon this township. Small game such as prairie-chickens and ruffed grouse were occasionally met with in this locality. Moose are common and several herds of fine elk were sighted.—*J. W. Tyrrell, D.L.S., 1907.*

25. This township may be most easily reached by taking trail or boat from Oak Point settlement or boat from Westbourne to Moosehorn Bay postoffice in township 26, range 8. From there I opened up a trail which runs southeast into township 25, range 8, and then in an easterly direction crossing ranges 8, 7 and 6, entering range 5, in section 18. The trail from there runs easterly and to the north of Little Birch lake leaving the township in section 13. The soil consists of a good black loam with a clay subsoil but is badly broken up by sloughs and lakes and not very desirable for farming purposes. The surface is gently rolling or level. The western half has been mostly burned over and is covered with poplar and willow scrub and some standing dead timber. The easterly half of the township has suffered very little from fire and is mostly covered with heavy bush. There is considerable spruce, tamarack, jackpine and poplar timber from ten to sixteen inches in diameter in the east half of the township. A little hay could be cut around most of the sloughs. There are numerous lakes and ponds which furnish a permanent supply of fresh water. There are no streams but the lakes are joined by wet sloughs in most cases. Frosts were quite common after August 18. There is an abundance of dry wood for fuel, but there are no lignite veins, stone quarries or minerals of economic value in the township. Moose, elk, bear and timber wolves are plentiful. There are a few partridges. Ducks were plentiful, while jackfish are found in most of the lakes.—*Chas. M. Teasdale, D.L.S., 1908.*

Range 6.

25. Moosehorn Bay postoffice in township 26, range 8, can be reached by trail from Oak Point settlement, or by boat from Oak Point or Westbourne. From there the trail runs in a southeasterly direction crossing the northerly part of township 25, range 8 and enters township 25, range 7, in section 31. From there it runs in a southeasterly direction about three miles and then easterly entering this township in section 18. It crosses the township in an easterly direction leaving it in section 13. The soil averages about six inches of black loam but has mostly a gravelly or stony subsoil and is not well adapted to farming. The surface is level or gently rolling and is covered with poplar and willow scrub and windfall. There is very little timber in the township as only small scattered clumps of spruce have escaped the fires which have destroyed the most of the timber. The timber is not suitable for lumbering but would make good building logs. Good hay is scarce. There is no surface water that is permanent but good water can be got by digging around any of the sloughs. There are no streams and no available water-powers. Hard frost appeared on August 18. Dry spruce and poplar wood is plentiful but there are no lignite veins, stone quarries nor minerals of economic value. Moose, elk deer, bear and prairie and timber wolves are abundant. There are a few prairie-chicken and partridge.—*Chas. M Teasdale, D.L.S., 1908.*

TOWNSHIPS WEST OF THE PRINCIPAL MERIDIAN.

Range 7.

25. This township can be reached by a trail from Oak Point settlement or by boat from Oak Point or Westbourne to Moosehorn Bay postoffice in township 26, range 8. From there I opened up a trail running southeast and crossing the northerly part of township 25, range 8, entering this township in section 31. There is considerable good farming land in this township but parts are broken by sloughs. The soil is a black loam with a good clay subsoil in most parts. The land is covered with scrub and a few small scattered clumps of spruce that have escaped the fire when the rest of the township has been burned. There are no large areas of timber and what there is would be suitable for logs for building purposes. There is very little hay as most of the sloughs do not produce grass suitable for hay. There are no permanent bodies of water but good water can be got by digging around any of the sloughs. There are no streams nor available water-power. Hard frost appeared on August 18. There is plenty of dry poplar and spruce for fuel but no lignite veins. There are no stone quarries but limestone comes to the surface in section 14. No minerals of economic value are known. Moose, elk, deer and bear are plentiful. There are some prairie-chickens and partridges and a few prairie and timber wolves.—*Chas. M. Teasdale, D.L.S., 1908.*

26. This township can be reached by taking trail or boat from Oak Point settlement or boat from Westbourne to Moosehorn Bay postoffice in township 26, range 8, from there following a camp trail that crosses the north part of township 25, range 8, and a trail which branches northeast from the main trail in section 30, township 25, range 7. There is considerable good land suitable for farming in this township. The soil is a black loam with a clay subsoil except in the northeast part of the township where the subsoil is more sandy or gravelly. The land is level or gently rolling and is covered with small poplar and willow scrub. There are a few clumps of spruce which have not been touched with fire which would supply good building logs. There is very little hay land. Very little permanent surface water appears, but good water can be got by digging a few feet near any of the sloughs. There are no streams or no available water-powers. Hard frost appeared on August 18 and 19. There is plenty of good dead spruce, poplar and jackpine for fuel, but there are no coal or lignite veins. No stone quarries nor minerals of economic value were found. Moose, elk, deer, bear and wolves are plentiful. There are a few prairie-chicken and partridge.—*Chas. M. Teasdale, D.L.S., 1908.*

Range 8.

25. The mail route running from Oak Point settlement to Fairford enters the township in section 30 and leaves it in section 32. This trail is very bad in wet weather. There is a line of boats running from Westbourne which calls at The Narrows, which is on the main trail in township 24, range 9. The soil is a black loam of from four to eight inches with a clay subsoil in most parts. The rock is only about one foot from the surface at the northeast corner of section 11. This township is best suited for mixed farming and stock raising, as it is mostly badly broken up by sloughs. The surface is level and covered with poplar and willow scrub and considerable areas of fair-sized poplar bush. There is some oak on the points running down into Dog lake and some bunches of spruce suitable for building purposes to the east of Moosehorn lakes. On dry years large quantities of hay could be cut to the north of Dog lake and around Moosehorn lakes and marsh. The water is all fresh and springs are quite common through the spruce. Moosehorn creek is very sluggish and in places is entirely lost in the marsh. Large areas of land were flooded to the north of Dog lake during the summer and fall, there being as much as two feet of water at some places where mounds and pits had been built on the base line. There

Range 8—Continued.

is no available water-power. The climate is very good. The summer is very free from frosts. Dry wood is plentiful as several areas have been burned recently, and the dead trees are still standing. No coal or lignite has been found. There are no known mineral deposits and there are no stone quarries. Moose, elk and deer are plentiful. There are a few chicken and grouse. Duck are plentiful during the summer and fall. Manitoba and Dog lakes are well supplied with whitefish, pickerel and pike. The smaller lakes are stocked chiefly with pike.—*C. M. Teasdale, D.L.S., 1907.*

26. There is a trail running from Oak Point settlement on the Canadian Northern railway to Fairford which enters the township in section 5, crossing on a sandbar at the mouth of Moosehorn creek, and leaves it in section 31. There is also a line of steamers which run from Westbourne on the Canadian Pacific railway calling at The Narrows which is on the main trail. The trail is very bad in wet weather. The soil consists of from four to eight inches of loam with a clay subsoil in most parts. This township is well adapted for mixed farming and stock raising as it is much broken by sloughs. The whole township is level and is mostly covered with from two to four inch poplar and willow scrub but there are some good sized poplars scattered through it. There are some clumps of spruce and poplar in the eastern part of the township which will furnish good building timber. Large quantities of good hay are found around the lakes and sloughs throughout the township. The water is all fresh. There are two very sluggish creeks, the country being very level. The land along the lake front often floods during stormy weather. There is no available water-power. The summers are very free from frosts. Wood is the only fuel as there are no coal or lignite deposits. No stone quarries nor minerals of economic value are known to exist. Moose, elk and deer are found in large numbers. There are a few prairie-chickens and grouse. Ducks are very plentiful during the fall. There are a few timber wolves. Foxes and prairie wolves are quite numerous. Whitefish, pickerel and pike are found in lake Manitoba. The inland lakes are all well stocked with pike.—*C. M. Teasdale, D.L.S., 1907.*

Range 9.

25. This township may be reached by a trail running from Oak Point settlement to Fairford which enters the township in section 3, and leaves in section 25. or by taking the steamers from Westbourne to The Narrows, and from there by trail which is very bad in wet weather. The soil is chiefly a shallow loam with gravel or clay subsoil. In the south part of sections 2 and 3 the rock comes close to the surface. It is best adapted to mixed farming. The surface is level and is covered with poplar two to four inches and willow scrub in most parts, as the timber has been destroyed by fire. There is some good-sized poplar on section 3 and spruce and poplar suitable for building purposes in sections 1, 12 and 13. There is considerable hay along lake Manitoba, but little could be cut around the sloughs without draining. The water is all fresh and is plentiful except in very dry seasons. There are no streams. All the hay lands along lake Manitoba is liable to be flooded owing to the rise caused by the wind and storms. There is no available water-power. Settlers report a moderate climate fairly free from summer frosts. Vegetables and corn are grown. Wood is used exclusively for fuel, and no coal or lignite veins are known. There are no stone quarries, and no minerals of economic value are known to exist. Moose, elk and deer are found in the eastern part of the township. There are some prairie-chickens, and grouse and ducks are plentiful. Whitefish, pickerel and pike are abundant in lake Manitoba.—*C. M. Teasdale, D.L.S., 1907.*

Range 9—Continued.

26. There is a trail running from Oak Point settlement to Fairford which enters the township in section 36 and leaves it in section 34. There is a line of steamers running from Westbourne that call at The Narrows, which is on the trail in township 24, range 9. The trail is very bad in wet weather. The soil is a black loam with a clay subsoil. It is best suited for mixed farming as most of the quarter sections are broken by sloughs. The surface is level and to the east of Elm creek is covered with willow, poplar and small birch. To the west of Elm creek it is covered with heavy bush of poplar, birch and scattered spruce of good size. Considerable hay could cut around the marshes which run back from the shores of lake Manitoba. Water would not be plentiful in dry years back from the lake as the sloughs are mostly shallow and there are no streams. The water in lake Manitoba is fresh. The marshes and hay lands along lake Manitoba are liable to be flooded during storms, as the shore is only a few feet above the usual level of the lake. The summers as a rule are free from frosts. Wood is the only fuel as there are no known deposits of coal or lignite. No stone quarries nor minerals of economic value are known to exist. Moose, elk and deer are plentiful. There are a few partridge, prairie-chicken and grouse. Ducks are plentiful along the lakes and marshes in the fall. Whitefish, pickerel and pike are very plentiful in lake Manitoba. Elm creek, which is a very deep bay running back from the lake is a good harbour, being sheltered, and having as great depth of water as lake Manitoba.—*C. M. Teasdale, D.L.S., 1907.*

Range 10.

27. There is no trail touching this township. In summer it could be most easily reached by boat from The Narrows or Fairford. The soil is a clay loam with a clay subsoil which should make good farming land. The surface is level and is covered with poplar and willow scrub. Considerable of the township has been burned over within a few years and the only bush of any size is along the lake in sections 35 and 26. Considerable hay could be cut on sections 23, 24 and 13. The country back from the lake is very dry. There are no streams. The marsh and hay land on sections 23, 24 and 13 is liable to be flooded as it is very low. There is no available water-power. The summers are usually free from frosts. There is an abundance of dry poplar all over the township, but there are no known veins of coal or lignite. No stone quarries nor minerals of economic value have been found. Moost, elk and deer are plentiful. There are a few partridge and prairie-chicken. Whitefish, pike nd pickerel are plentiful in lake Manitoba.—*C. M. Teasdale, D.L.S., 1907.*

28. This township may be reached by a trail leading from Oak Point settlement to Fairford which enters the township in section 24 and leaves it in section 36. On account of the very level country and numerous sloughs the trail is very bad in wet seasons. There is a line of steamers running from Westbourne to Gypsumville which call at The Narrows in township 24, range 9 and from there the township can be reached by a sailboat. The soil is loam which tends to get lighter towards the eastern portion of the township. It is best adapted to mixed farming and stock raising as there is good grazing throughout the scrubby portions of the township. The surface is level except in section 33 which is slightly rolling and is covered with bush and scrub. Most of the timber except in sections 9, 16, and part of 28 has been destroyed by fire. The timber there is practically all poplar which is of good size but there are a few scattered spruce and oak. Hay is not very plentiful but some might be cut along the west shore north from Elm point in section 9. Besides lake Manitoba the only permanent body of water is a lake on sections 34 and 35 which contains fresh

Range 10—Continued.

water. There are no streams and the land is not liable to be flooded. There is no available water-power. Settlers at Fairford and south along the lake report a very favourable summer and grow all kinds of vegetables but no grain has been grown yet. Dry wood is quite plentiful in all parts of the township. No coal or lignite is known to occur. There is an outcrop of limestone on the shore of lake Manitoba in section 33 at Steep Rock point. Rock also comes to the surface in many places throughout the township. No minerals of economic value are known to exist. Moose, elk and deer are fairly plentiful. There are also a few prairie-chicken and grouse.—*C. M. Teasdale, D.L.S., 1907.*

29. (East outline.) The surface of this township is almost level and is only a few feet above the surface of lake Manitoba. It is chiefly covered with small poplar alternating with willow swamps, muskegs and small hay meadows,. The largest muskegs are on the east boundaries of sections 24, 25 and 36. The soil is chiefly black loam from two to eight inches in depth on a subsoil of clay and gravel. At the time of the survey (June) all the willow swamps and hay meadows were full of water. A wagon road leading from Oak Point to Fairford crosses this township. Moose, elk and jumping deer are plentiful in this vicinity. A few partridge and duck were also seen.—*William Christie, D.L.S., 1908.*

30. (East outline.) Fairford river, which is the outlet of lake Manitoba, flowing in a northeasterly direction, crosses the line in section 24. At this place the river is one hundred and twenty yards wide and has an average depth of about eight feet and a fairly rapid current. South of the river the line passes over level land only a few feet above the level of the lake. Several small sloughs and hay meadows, all of which were covered with water at the time of the survey (June) were crossed. A small creek, which flows northwest into lake Manitoba, was crossed in section 12. The dry land is covered chiefly with poplar from two to five inches in diameter and thick willow scrub. On the east boundary of section 13 some brulé and windfall was crossed. Fairford Indian reserve No. 50 is crossed by this outline. It occupies the portion of section 24 south of Fairford river and also a part of section 13. North of the river the surface is also nearly level. The timber here is somewhat larger than on the south side of the river, poplar and spruce up to seven inches in diameter occurring. Small sloughs and willow swamps are also numerous and a tamarack swamp occurs in section 36. The soil is chiefly black loam, from five to eight inches in depth on a clay subsoil, but gravel occurs in a few places. The road from Oak Point to Fairford crosses this township. Moose, elk and jumping deer are said to be plentiful here. A few partridge and duck were also seen.—*Wm. Christie, D.L.S., 1908.*

31. (East outline.) The soil along this outline is inclined to be gravelly and stony, especially on the east boundaries of sections 24 and 13. The surface is very gently undulating, and along the east boundaries of sections 24 and 13 is covered with small jackpine, poplar and birch. The east boundaries of sections 12 and 1 pass through brulé with a thick growth of small poplar and willow. A trail leading from Gypsumville to Pineimuta lake crosses the line in section 24. No sloughs or hay meadows were seen along this line, but hay can be obtained at Pineimuta lake in township 31, range 9. Moose are said to be plentiful here, but beyond a few partridge no game was seen by any of the party during the survey. Duck, however, are plentiful at Pineimuta lake in township 31, range 9.—*Wm. Christie, DL..S., 1908.*

Range 11.

22. This township may be reached by a good trail from Westbourne or Gladstone, stations on the Yorkton branch of the Canadian Pacific railway. There is also a

Range 11—Continued.

trail from Makinak but about half of the distance is through bush and marsh and in some seasons would be almost impassable. This township is level except for a few ridges running generally in a northerly and southerly direction. The soil in the southeasterly part of the township is black loam from six inches to a foot in depth with clay subsoil and stones. In the rest of the township it is generally sandy and stony. The southeasterly part of the township is covered with a thick growth of white poplar from eight to twelve inches in diameter. On sections 20 and 21 there is a small bluff of spruce suitable for building purposes. The rest of the township is covered with poplar, willow scrub and thick underbrush with dead standing poplar in places. On a great many sections there is a lot of fallen poplar, and thick willow and poplar scrub so that it would require considerable work to clear the land. There is some hay along Garrock creek, a stream of good water some fifteen links wide which enters the township on section 3 and runs northeasterly into lake Manitoba. Most of the hay is cut in the sloughs which are scattered throughout the township and the marsh adjoining Ebb-and-Flow lake. Reedy creek a stream of good water ten to fifteen links wide rises in lake No. 1 and flows northeasterly into Ebb-and-Flow lake. Lake No. 1 is situated in the extreme west of the township, contains good water and has a high and dry beach at the northeasterly corner. There is some hay land adjoining lake No. 1 in many places and large marshes on the north and south sides. There are no water-powers, stone quarries or minerals of economic value in the township. The settlers are mostly halfbreeds, descendants of the early settlers who are engaged in cattle raising, fishing and hunting. This last season a number of English and American settlers have taken up land. The township is well adapted for mixed farming and will no doubt be well settled in the near future as the Canadian Northern railway is building a railway to Makinak which will pass close to this township. Game such as moose and elk is plentiful and lake Manitoba abounds with the usual fish of this western country. This part seems to be free from summer frosts; vegetables do well and attain great perfection. Kinosota postoffice is situated on one of the lake lots in front of the township. There is a church and school at Kinosota. —*W. J. Deans, D.L.S., 1908.*

23. This township may be reached by a good trail running from Westbourne or Gladstone stations on the northwestern branch of the Canadian Pacific railway. The surface is level and covered with a thick growth of willow and poplar scrub with standing dry poplar and windfall. On sections 3, 4, 5 and 17 there is some white poplar averaging eight inches in diameter. Section 8 is covered with spruce and poplar averaging eight inches in diameter. The soil consists of six inches of black loam with clay, stones and gravel, except that portion lying west of the marsh along Ebb-and-Flow lake which is black loam and sandy subsoil. The cultivated land is confined to a small strip west of the marsh. Ebb-and-Flow lake occupies the easterly part of the township. There is sufficient hay for the requirements of the settlers in the marshes adjoining the lake. Reedy creek, a small stream of good water, enters Ebb-and-Flow lake on lot No. 2. The principal settlers are half breeds who are engaged in cattle raising, fishing and hunting. The settlers depend largely on the fishing industry as a means of making a living. Jackfish, whitefish, tullibee and pickerel abound in the lake of which large quantities are caught and shipped to Westbourne. The want of railway communication is a serious drawback to the settlement of this part of the country. There are no stone quarries, water-powers or minerals of economic value. Game such as moose and elk are moderately plentiful. Small fruit such as raspberries, saskatoon berries and cranberries are plentiful. This part is free from summer frosts and vegetables do well, although the settlers do not appear to do much in gardening, confining their efforts to other pursuits.—*W. J. Deans, D.L.S., 1908.*

TOWNSHIPS WEST OF THE PRINCIPAL MERIDIAN.

Range 11—Continued.

27. This township can be best reached by boat from The Narrows or from Fairford. The whole township consists of a marsh with a beach about a chain wide on the west side which is covered with elm, maple, poplar and willow. A little hay could be cut along the shore in dry years. There are some small ponds and a small lake along the west side of the marsh. The whole marsh is on practically the same level as lake Manitoba and is liable to be flooded. There are no indications of summer frosts. A little wood is found along the west shore. There are no known coal or lignite veins in the township. No stone quarries nor minerals of economic value have been found. Ducks are very plentiful during the summer and fall. Whitefish, pickerel and pike are found in lake Manitoba.—*C. M. Teasdale, D.L.S., 1907.*

28. This township can only be reached by boat in the summer. There is a good beach and harbour in the northeast of section 14 where boats go in for wood. The soil in the bush is a clay or clay loam, but towards the shore it is a loam with gravelly or stony subsoil. It is best adapted to stock raising. The surface is level. Sections 33 and 34 and the easterly portions of 32, 27, 22. 15, and 10, also the westerly portions of 35, 26, 23, 14 and 11 are covered with poplar bush and willow scrub, considerable of which has been killed by fire. The remainder of the township is principally slough and marsh. Large quantities of hay could be cut as there is considerable land high enough all around the bush to produce the best of hay. The most of the land that is not covered by bush is marshy and does not produce hay. Several lakes and ponds occur through the marsh in the westerly portion of the township. There is very little alkali in any of the water. The whole of the township is very low and at high water and during storms, floods the marshes to the bush. There are no streams and there is no available water-power. Summer frosts are said to be rare. There are no stone quarries or minerals of economic value. Moose are very plentiful in this township, several being seen during the survey. There is an abundance of whitefish, pike and pickerel in lake Manitoba.—*Chas. M. Teasdale, D.L.S., 1907.*

Range 12.

27 & 28. Makinak, on the Canadian Northern railway, is the nearest railroad point to this township. Township 27 is very flat and wet. Fully two-thirds of it is hay slough and very wet marsh. The soil consists of a few inches of sandy loam over a hardpan clay with gravel and boulders. If drained it would make excellent grazing land and would be suitable for stock raising. The part lying along lake Manitoba, for an average distance of about one-half mile from the lake, is wet marsh with bunches of willow. Township 28 is very similar, except that there is more woods, a low flat ridge of thick growing small poplar running nearly north through it. This ridge, only a few feet above the rest of the township, is broken by numerous sloughs and marshes. The soil is poor and stony. Township 27 is rather open, about two-thirds of it being hay slough and marsh, the remainder is covered by small poplar, willow and scrub. The country is so flat and low, being only a few feet in any place above the level of lake Manitoba that it would be difficult to drain it. Without drainage, except in dry seasons, the country would be useless for either farming or stock raising. In township 27 there is very little wood of any use. There are some bluffs in the southwest portion, having trees of poplar from three to four inches in diameter suitable for firewood. The most of the timber growth in this township is small poplar, willow and scrub, of no use for any purpose. In township 28 there is more timber growth, all poplar. Some small building logs could be got in this township, but the most of the timber is only fit for firewood. In dry seasons an abundance of hay could be cut in these townships.

Range 12—Continued.

Nearly every section has its hay sloughs, but the most of the hay is to be found in township 27 back from and parallel to lake Manitoba. Without drainage it is only in dry seasons that much hay could be cut. There are no streams in these townships, and no water-powers, but there is an excess of water everywhere. I found the marshes and sloughs everywhere covered with from six inches to three or four feet of water. This water is somewhat hard but of fairly good quality. The climate is similar to that of the rest of Manitoba. There would likely be considerable summer frost. Wood is the only fuel. No stone was seen except boulders, of which there are plenty of all sizes, but they are not suitable for building purposes. No indications of minerals were observed. There are some moose, elk and jumping deer. Very few partridge or prairie-chicken were seen. There are quite a number of muskrat and some mink. A few coyotes or prairie wolves were seen. In seasons there is a large number of wild duck.—*P. T. C. Dumais, D.L.S., 1907.*

Range 13.

27. Makinak, a small town on the Canadian Northern railway is the most convenient railroad point. There is very little good land in this township. It consists of a few inches of loam over a subsoil of hardpan clay, gravel or boulders. About one-third of the area is marsh or wet hay slough. If the country was properly drained, stock raising could be carried on in a small way but the country is so low and flat, being in no place more than a few feet above the level of lake Manitoba, that draining would be a difficult and expensive undertaking. As it is at present, it would be impracticable to farm in any way, except in very dry seasons. Some years ago, a Mr. Prime settled in section 29, and for a few years tried stock raising, but on account of the dampness of the country abandoned the attempt and moved elsewhere. There is no true prairie here. There are a few small areas of open country, caused by repeated fires destroying the surface soil and leaving the ground so poor that nothing grows, except some miserable grasses and stunted scrub. About one-third of this township is marsh, open water and wet hay slough, the remainder is covered by poplar of different sizes, mostly small, willow large and small and scrub. If the country was properly drained mixed farming could be carried on or stock raising in a small way. In section 14 there is a bluff of excellent poplar covering an area of seventy or eighty acres. The trees in this bluff run from eight to eighteen inches, and are long and clean in the trunk, making excellent building material. At one time there was considerable large poplar but fires have destroyed this. At present there is plenty of poplar large enough for firewood, with a few green spruce of scrubby kind. There are quite a number of hay sloughs in this township, and in dry seasons a large quantity of excellent hay could be cut. Nearly every section has more or less of hay slough and hay in some places could be cut around the edges of the marshes. If properly drained this township would produce good hay. There is an excess of water, most of it of a fairly good quality. The water in the marshes, muskegs and sloughs is hard, but not so hard as in some other places. I have no doubt that water could be had in any part of this township by digging shallow wells. There are no streams, or water-powers. The climate is similar to that of the rest of Manitoba. Wood is the only fuel and at present there is an abundant supply. No stone except boulders of different sizes was seen; these are to be found in nearly every section, but they are not suitable for building purposes. No indications of minerals were observed. There are some moose, elk and jumping deer. Very few partridge or prairie-chicken were seen and very few rabbits. There are quite a number of muskrat and no doubt some mink. Many coyotes or prairie wolves were seen.—*P. T. C. Dumais, D.L.S., 1907.*

Range 13—Continued.

28. Makinak, a small town on the Canadian Northern railway, is the most convenient railroad point. With the exception of a portion of sections 6, 7 and 18, the soil in this township is a few inches of loam over a subsoil of hardpan, clay, gravel or boulders. About one-quarter of the area of this township is marsh and slough. If properly drained and roads opened giving access to the railroad, mixed farming in a small way could be carried on. The country is so flat that it would be a difficult and expensive undertaking to drain it. There is no prairie. About one-quarter of the area is marsh and slough, the rest is timbered with poplar, mostly of small size, very little of it large enough for building purposes, with willow and scrub. The most extensive marshes are in the centre and southerly sides of this township. The sloughs are mostly of a marshy character and are pretty well distributed, nearly every section having more or less slough. The timber is nearly all poplar. There are a few scattered spruce of the brushy kind. Fires have run through this country some years ago, killing the poplar. Winds have felled a lot of this fire-killed timber and at present there is a thick second growth of poplar and willow, mixed with this dead timber. Fires have done less damage through the west side of the township and here there is better poplar, but very little of it is large enough for building purposes. A large quantity of wild hay could be cut here in dry seasons. There are a number of hay sloughs, and some hay might be cut around the marshes. Along the valley of Crane river through sections 8, 7 and 18 there are excellent hay meadows. Altogether, I am of the opinion that there is sufficient wild hay for settlers' needs. There is an over supply of water in this township. The water in the marshes, muskegs and sloughs is moderately hard. There is only one stream, Crane river. This flows out of the big marsh, north of Primes lake, in section 5, through the southwest corner of section 8, through sections 7, 18 and a portion of 19. The water in this stream is of excellent quality. It is from forty to fifty links wide and has an average depth of from twelve to twenty inches, with a current of about three miles per hour. There are excellent hay meadows along this stream but they are subject to flooding. In high water the depth of this stream, in the main channel, would be five or six feet, and on account of low banks, the water would spread over the meadows. There are no water-powers. The climate is similar to that of the rest of Manitoba. There are likely summer frosts. Wood is the only fuel and, at present there is an abundant supply of it. Only boulders of different sizes were seen. These are to be found in nearly every section, but they are not suitable for building purposes. No indications of minerals were observed. There are some moose, elk and jumping deer. Very few partridge and prairie-chicken were seen, and very few rabbits. There are quite a number of prairie wolves and some muskrat and mink.—*P. T. C. Dumais, D.L.S., 1907.*

Range 14.

27. The most convenient route for reaching this township is from East Bay post-office by way of Makinak on the Canadian Northern railway. A road leads through township 27, range 15, about four miles west of this township. There is a trail through township 27, range 15 which enters this township on the south boundary of section 30 and runs easterly. The soil varies from a dark clay loam to clay and gravel mixed with stones. About one-sixth of this township is waste land, the surface being very flat, there are many marshes and sloughs. This renders it unfit for farming to a great extent unless drained. This township is most valuable for its timber; there is a considerable area covered by poplar three to sixteen inches in diameter and scattered spruce fit for lumber. There are some good hay meadows but at present they are

covered with water. It is said that this year was exceptionally wet and more water than usual is on these meadows. There are many salt springs and ponds as well as fresh water marshes and slough. The climate this winter was exceedingly fine. Snow fell to the depth of about two and a half feet in the bush. Of the economic minerals limestone was the only one observed and that only in drift boulders. Game is plentiful, consisting of rabbit, muskrat, prairie-chicken, partridge, duck and geese. Moose, elk and jumping deer are quite numerous, also small wolves and foxes. There are no settlers in this township.—*Adam Fawcett, D.L.S., 1907.*

28. The most convenient route for reaching this township is from East Bay post-office by way of Makinak on the Canadian Northern railway. A trail passes through township 27, about two miles south of the south boundary of township 28, which makes it easy to reach this township in a dry season. The soil varies from a dark clay loam to clay and gravel, mixed with stone. About one-fifth of the township is waste owing to the level nature of the country. There are many marshes and sloughs, which render it unfit for farming, to a great extent, until drained. There is a small stream called Crane river, which enters the township on the east boundary of section 25 and flows northerly across section 36; this stream is about thirty links wide, five feet in depth and contains good water. There is considerable poplar timber in this township suitable for cordwood, and some lumber timber varying from three to twelve inches in diameter. There are some good hay meadows, but at present they are mostly covered with water, it is said that this year has been exceedingly wet and more water than usual is on these meadows. There are many salt springs and ponds as well as fresh water marshes and sloughs. The climate this winter was exceptionally fine; the snow was about thirty inches deep in the bush. Of the economic minerals, limestone was the only one observed and that in drift boulders. Game is plentiful, moose, elk, jumping deer being quite numerous, also small foxes and wolves, rabbits, muskrat, partridge, prairie-chicken, duck and geese. There are no settlers in this township.—*Adam Fawcett, D.L.S., 1907.*

29. The most direct route to this township is by way of Winnipegosis on the Canadian Northern railway. There is a wagon trail from this station to Crane River reserve which passes through this township. The soil in the township varies from clay loam to clay, sand, stone and gravel. About one-fifth of this township is waste land owing to the level nature of the country. There is considerable bush in the township but it is of inferior quality, being small and scrubby, fit only for fence rails and fuel. There are several hay meadows, sloughs and ponds which at the present time (February) are covered with water. There are many salt springs and ponds as well as fresh water marshes and sloughs. The settlers near by state that this season has been exceedingly wet and more water than usual is on these meadows. Crane river, a small stream, flows through section 1 into lake Manitoba. The climate this winter was very fine, bad weather lasting for only one day. Snow fell to a depth of two and a half feet. Limestone was the only mineral of economic value observed, and that was seen in floating drift boulders. Game is very plentiful, consisting of moose, elk, jumping deer, also some black bear, small wolves and foxes. Rabbits, muskrats, mink, prairie-cricken, duck and geese are found in season. There are no settlers in this township.—*Adam Fawcett, D.L.S., 1907.*

30. The most convenient route for reaching this township is by way of Winnipegosis, a station on the Canadian Northern railway, from which place there is a wagon trail to the Crane River reserve. This trail passes a little more than a mile south of the south boundary of the township. The soil varies from a dark loam to clay and gravel and stone. About one-quarter of the township is waste land owing to the level nature

Range 14—Continued.

of the country. There are a good many marshes, ponds and sloughs, which render it unsuitable for farming purposes. There are some salt springs and ponds as well as fresh water marshes and sloughs. The water is alkaline in some ponds. Along the shore of lake Manitoba are some good hay meadows. There is considerable poplar, suitable for cordwood, and some scattered oak, spruce and tamarack. The weather was exceedingly fine, snow fell to the depth of thirty inches in the bush during the winter, and the weather was mild and clear. Of the economic minerals, limestone was the only one observed and that only in drift. Game is plentiful, consisting of moose, elk, jumping deer, small wolves, foxes, rabbits and muskrats. The rabbits are not so numerous as formerly. There are partridge, prairie-chicken, ducks and geese in season. Fish of many varieties are found in lake Manitoba. There is one settler in this township on the northeast quarter of section 12.—*Adam Fawcett, D.L.S., 1907.*

31. The most convenient route to this township is by way of Winnipegosis, on the Canadian Northern railway. There is a wagon trail from Winnipegosis to Crane River reserve. This trail passes through township 29, about seven miles to the south of the south boundary of the township. The land is not of much value, as the timber is mostly poplar and willow scrub, with an occasional spruce tree, and is of inferior quality. The township is too broken for farming, with marshes and sloughs, and is mostly covered by lake Manitoba. The soil is of good quality, dark clay loam to clay and gravel mixed with stone. Game is plentiful, consisting of moose, elk, jumping deer, small wolves, foxes, partridge, mink, muskrat and fish in great variety. No minerals were observed. There are no settlers in this township.—*Adam Fawcett, D.L.S., 1907.*

Range 15.

30 & 31. The land on the east boundary of township 30 is gently rolling, covered with scrub poplar, oak and willow, with a few scattered spruce and ash. The land in sections 1 and 2 of township 31 is low lying, covered with scrub, poplar and willow, and is valuable only for fuel. The most convenient route for reaching these townships is by way of Winnipegosis, on the Canadian Northern railway, from which place there is a wagon trail to the Crane River reserve. This trail passes a little over a mile south of the south boundary of township 30. The soil in township 31 varies from a dark loam to clay and gravel, mixed with stone. No minerals were found. Game is plentiful, consisting of moose, elk and jumping deer, small wolves, foxes, rabbits, muskrats, partridge and prairie-chicken, ducks and geese. In lake Manitoba fish of many varieties are found. There are no settlers.—*Adam Fawcett, D.L.S., 1907.*

Range 16.

31. (East outline.) This outline passes through second growth poplar from two to five inches in diameter with some willow and old brulé. The surface is almost level, and the soil consists of black loam from five to eight inches in depth on a subsoil of clay with gravel in a few places. Some small hay meadows occur in sections 12 and 1. No coal, stone quarries or minerals of economic value were noted. Moose and jumping deer are plentiful. A few partridge were also seen and duck are plentiful in lake Winnipegosis.—*Wm. Christie, D.L.S., 1908.*

32. (East outline.) The surface along this outline is nearly level. The soil is mostly good, consisting of black loam from four to eight inches in depth on a clay subsoil. In a few places, however, gravel occurs. A spruce and tamarack swamp about half a mile in width is crossed by the east boundary of sections 25 and 24. The

Range 16—Continued.

remainder of the outline passes through small poplar, willow and jackpine with brulé. In section 1 the second growth poplar has attained a diameter of five inches. No stone quarries, coal or minerals of economic value were noted. Moose and jumping deer are plentiful. A few partridge and coyotes were also seen, and ducks are plentiful in lake Winnipegosis, an arm of which extends through this township from south to north.—*Wm. Christie, D.L.S., 1908.*

36. (North outline.) This township borders on Waterhen lake to the east. The west shore of the lake crosses the outline in section 36. The surface is nearly level and is mostly swampy. A lake about one-quarter of a mile wide by one mile long is crossed by the north boundary of section 32. A large muskeg extends for a considerable distance north from this lake. Large muskegs and tamarack swamps are also crossed by the north boundaries of sections 34 and 35. In section 31 a strip of green spruce from two inches to eight inches in diameter occurs. The remainder of the outline passes through small poplar, spruce and jackpine, with old brulé. The soil is black loam from five to ten inches in depth on a clay subsoil. No coal, stone quarries or minerals of economic value were noted. Moose and jumping deer are said to be plentiful. A few partridge were also seen and ducks are plentiful in Waterhen lake.—*Wm. Christie, D.L.S., 1908.*

Range 17.

33. (East outline.) This outline passes through almost level country, most of which is low and swampy. The greater part of the east boundary of section 1 lies in a large marsh adjoining lake Winnipegosis. Hay might be cut on part of this marsh when the water is low in the lake. The hay land in this vicinity, however, is liable to be flooded at any time, owing to the fact that a strong north wind often raises the water in the south end of lake Winnipegosis as much as three feet, flooding a large part of the hay land in the immediate vicinity of the lake. On the east boundary of sections 12 and 13 a lake about three-quarters of a mile wide and one mile long was crossed. This lake is surrounded by a strip of muskeg and hay land about half a mile in width. A large muskeg is also crossed by the east boundary of section 36, while small hay meadows are quite numerous all along the outline. The dry land between these marshes is covered with poplar and spruce up to six inches in diameter. The soil is chiefly black loam from five to eight inches in depth on clay subsoil. In a few places, however, gravel occurs. No coal, stone quarries, or minerals of economic value were noted. Moose and jumping deer are plentiful. A few coyotes, rabbits and partridge also occur, and ducks are very plentiful.—*Wm. Christie, D.L.S., 1908.*

34. (East outline.) The soil along the line consists of black loam, from five to eight inches in depth, on a clay subsoil. The surface is almost level. Numerous small hay meadows are crossed by the east boundaries of sections 12, 13 and the south half of 25. A muskeg about a mile long by half a mile wide is crossed by the east boundary of sections 25 and 36. The rest of the outline passes through poplar, spruce and tamarack up to six inches in diameter, with old brulé in places. No coal, lignite, stone quarries or minerals of economic value were noted. Moose and jumping deer are plentiful. A few coyotes, rabbits and partridge were also seen.—*Wm. Christie, D.L.S., 1908.*

35. (East outline.) The country passed over by this outline is nearly level and is chiefly covered with poplar, spruce and tamarack up to six inches in diameter, with old brulé. In section 12 spruce and poplar up to fourteen inches in diameter is found. A lake about half a mile wide by one and one-half miles long is crossed by

Range 17—Continued.

the east boundary of section 13. The greater part of this lake lies in township 35, range 16. A large muskeg surrounds this lake. The soil is black loam, from five to ten inches in depth, on a clay subsoil. Very little hay land was seen along this line. No minerals of economic value or no stone quarries were noted. Moose and jumping deer are found. A few partridge were also seen.—*Wm. Christie, D.L.S., 1908.*

36. (East and north outlines.) The surface of this township so far as could be seen from these outlines is nearly level and contains several large muskegs. A large muskeg occupies the greater part of section 1, another is crossed by the east boundary of section 13 and still another by the east boundary of section 36, while a fourth is crossed by the north boundary of section 34. The rest of the township is chiefly covered with small poplar, spruce, jackpine and tamarack, with old brulé. A strip of spruce, some of which has attained a diameter of ten inches, occurs in section 34, east of the muskeg mentioned above. The soil is chiefly black loam, from five to ten inches in depth, on a clay subsoil. An excellent harbour almost one-half mile wide by one mile long, known as McAuley's harbour, lies in section 33. The entrance to this harbour from lake Winnipegosis is in section 4, township 37, range 17, Point Brabant, on the east shore of lake Winnipegosis, in this township, consists of a cliff of limestone about twenty feet high. It is possible that stone might be quarried here. No coal or minerals were noted. Moose and jumping deer are said to be plentiful. A few partridge and duck were the only game seen during the course of the survey.—*Wm. Christie, D.L.S., 1908.*

Range 18.

28. Fractional sections 25 and 36 are situated at the northeast corner of Dauphin lake. The surface is level and covered with willow and poplar scrub. The soil is black loam ten inches deep, with sand, stone and clay. The land is marshy along the shore of the lake. The water in the lake is good. Summer frosts are unheard of.—*W. J. Deans, D.L.S., 1908.*

Range 20.

23. Sections 35 and 36 of this township are north of the Riding Mountain forest reserve. On the east half of section 35 and the west half of section 36 there is a heavy poplar bush. The remainder of these sections is covered with scrub. A small stream crosses the east boundary of section 35 and flows westerly into Vermilion river. This river crosses the north boundary of section 26, flowing northerly. The soil is black loam, eight or ten inches deep, with clay and gravel. Building material is plentiful and there is an abundance of wood for fuel. The water in the streams is good. Hay is very scarce.—*W. J. Deans, D.L.S., 1908.*

35. There is a fair wagon road from Winnipegosis to Pine creek and Duck bay which runs northerly about one mile east of the easterly boundary of this township and from which a few rough wagon trails and hay roads enter this township on the east side. There is also a rough wagon trail cut through from the Indian reserve to Cowan, a station on the Prince Albert branch of the Canadian Northern railway, but this latter must be quite impassable during the summer on account of water. The soil consists of from four to ten inches of black loam overlying sand or gravel and must be regarded as ranging between second and third class and as being more suitable for cattle raising than for grain growing. The surface is level throughout and covered with brulé and second growth poplar for the most part, except in sections 1, 2, 3, 11 and 12, where there are some big alkaline hay marshes. All along the west boundary of the township the surface consists of jackpine gravel ridges alternating with long

TOWNSHIPS WEST OF THE PRINCIPAL MERIDIAN.

Range 20—Continued.

stretches of what looks like muskeg but cannot properly be so described, being a covering of moss from six to eighteen inches thick, overlying gravel, boulders and limestone shale. There is no marketable timber in this township, almost all the original timber having been destroyed by fire. What there is consists of second growth poplar chiefly, grown up since the date of the last big fire, apparently about sixteen or seventeen years ago. What timber remains consists of poplar from six to ten inches, with some spruce along the river banks. There are numerous hay sloughs throughout this township, on some of which the Indians put up large quantities of hay every year. This hay is distinctly what is called 'slough' hay, there being very little of what may be called hay meadow, i. e., lands which grow red-top, blue-joint or other upland hay. The township is abundantly watered by three large streams, South Duck river, a branch of the same to the west of it, and Pine creek, all of which are permanent and are somewhat alkaline. South Duck river is about eighty feet wide, with banks from eight to fourteen feet high, and varies in depth from one to seven feet at ordinary water with a current that varies correspondingly from one and one-half miles per hour to an imperceptible rate. The other two creeks are from forty-five to sixty feet wide and in depth, height of banks and current are similar to South Duck river. On all these creeks it is noticeable that in spring the water must at times overflow their banks,, but these occasions are comparatively rare. There are no available waterfalls or powers in this township and I saw no sign of minerals or quarrying stone. There is abundant wood fuel to last settlers for many years to come. Moose, deer and bear are found in this township and there are beaver colonies in active operation this fall on all three of the above mentioned creeks, a fact which reflects a great deal of credit on the local traders, hunters and Indians, when it is considered that one of these colonies on South Duck river is within four miles of the trading post at Pine Creek.—*R. W. Cautley, D.L.S., 1908.*

Range 21.

23. Sections 12 and 13 of this township are heavily timbered with poplar, ten inches in diameter. The soil is black loam, eight inches deep, with clay subsoil. The surface is gently rolling. A small stream running easterly crosses the east boundary of section 11 and the north boundary of section 12. There is a large hay meadow on section 13. The water is good and building material and fuel are plentiful.—*W. J. Deans, D.L.S., 1908.*

31. Sections 1, 2, 3, 4, 5 and 6 are low and wet, covered with willow and poplar scrub, with many large hay marshes in which large quantities of hay might be cut, but which are now neglected, the settlers having abandoned their homesteads on account of the country being flooded in wet seasons. The great need of this locality is drainage. If properly drained this would be a great cattle country and would soon be well settled. The water in the marshes is fresh and good. There is some building timber on sections 1 and 6 and abundant standing dry trees for fuel.—*W. J. Deans, D.L.S., 1908.*

Range 23.

29. Sections 1, 12, 13, 24, 25 and 36 are east of the Duck Mountain forest reserve. The surface is gently rolling, covered with a thick growth of poplar, and poplar and willow scrub. Section 1 is heavily covered with spruce, averaging ten inches in diameter. The soil is clay with stones and gravel. The water both in sloughs and streams is good. Hay is very scarce and hard to get. Building timber is plentiful and there is wood for fuel in abundance. These sections are nearly all taken up and on some of the sections the settlers have made substantial improvements. —*W. J. Deans, D.L.S., 1908.*

TOWNSHIPS WEST OF THE PRINCIPAL MERIDIAN.

Range 23—Continued.

30. Sections 1, 12, 13, 24, 25 and 36 are east of the Duck Mountain forest reserve. The sections are rolling and broken up by valleys of streams on sections 1, 12, 24, 25 and 36. All of these sections are covered with thick poplar and willow scrub. On section 13 there is some spruce, averaging ten inches in diameter. There is sufficient timber for the requirements of the settlers and abundance of fallen timber for fuel. The soil is clay with sand and gravel. The water in the streams is good. Hay is very scarce. Most of the sections are settled on and the occupants have made great strides for the short time they have been on the land.—*W. J. Deans, D.L.S., 1908.*

Range 24.

26. Sections 21, 28 and 33 are situated east of the Duck Mountain forest reserve. The surface is heavily rolling and covered with poplar and willow scrub. The soil is black loam, eight to ten inches deep with clay, sand and stones. There were no settlers on these sections at the time of survey. The water in the sloughs and streams is good. There is some good poplar suitable for building purposes on section 28.—*W. J. Deans, D.L.S. 1908.*

Range 26.

23. Section 6 is rolling prairie, scrubby in the south part, with a few hay marshes. The soil is black loam, twelve inches deep, with clay subsoil. The settlers are engaged in mixed farming. Fuel can be obtained nearby on the Riding mountains where there is any amount of fallen timber suitable for that purpose. The water is good in the sloughs and wells.—*W. J. Deans, D.L.S., 1908.*

Range 30.

24. This township may be easily reached by a good trail running from Langenburg a station on the Northwestern branch of the Canadian Pacific railway. The surface is rolling and mostly open prairie with a few bluffs of small poplar, the soil is black loam, from eight to twelve inches deep, with clay subsoil. The township is well adapted for mixed farming as there are many small hay marshes and sloughs in which there is an abundance of water and around which large quantities of hay can be cut. There is no available land in this township for homesteading, but a large area of the best land is in the hands of speculators who are no doubt holding it expecting a big price as soon as the Canadian Northern railway, in course of construction, reaches this part. The township is settled with Galicians and people from the eastern provinces. Good water is hard to obtain, the well water being highly impregnated with mineral; the slough water is mostly alkaline, but cattle like it. The settlers are all engaged in mixed farming and appear to be prospering. This section of country has been unfortunate in regard to summer frosts; for two seasons the grain has been frozen as well as the vegetables, but no doubt the frosts will disappear when cultivation becomes more general. There is no timber in the township and the settlers have to go long distances to obtain sufficient for building purposes and fuel. There are no water-powers, stone quarries or minerals of economic value in the township. Wild duck are plentiful in season, and there are a few prairie-chicken, but the latter are becoming very scarce.—*W. J. Deans, D.L.S., 1908.*

Range 31.

29. Sections 33, 28 and 21, outside of Coté Indian reserve No. 64, are covered with small poplar and willow scrub, with small openings of clear prairie. The surface is

TOWNSHIPS WEST OF THE PRINCIPAL MERIDIAN.

Range 31—Continued.

rolling and the soil is black loam with clay subsoil. Sections 20 and 19 are rolling and covered with small poplar and willow scrub. The soil is black loam inclined to be sandy. The Indian school is situated on section 19, a large part of which is under cultivation.—*W. J. Deans, D.L.S., 1907.*

30. The westerly half of this township lies in the Coté Indian reserve No. 64, and may be easily reached by numerous trails from the village of Kamsack, a divisional point on the Canadian Northern railway. The soil generally is a rich black loam and well adapted for the production of wheat and oats. The surface is rolling and covered with small poplar, and poplar and willow scrub, with numerous small clearings. The poplar did not exceed four inches in diameter and would not be large enough for building purposes, but would do for fencing and fuel. There is enough hay throughout the township to supply the ordinary requirements of the settlers. There are numerous small creeks of good fresh water and a large number of the sloughs contain potable water. There are no water-powers, stone quarries or minerals of economic value in the township. The easterly portion of this township being on Duck mountains is much rougher and more broken than the westerly half. Game, such as wild duck and prairie-chicken is numerous. Elk and moose were seen but were very wild. There are a few settlers in the easterly part of the township who are engaged in mixed farming and appear to be doing well.—*W. J. Deans, D.L.S., 1907.*

31. Along the easterly boundaries of sections 15 and 22 the country is open prairie with scattered scrub, except at the northeast corner of section 22 where it is flat and wet in places. The north boundaries of sections 19, 20, 21 and 22 pass through a rolling country covered with a thick growth of poplar from four to six inches in diameter. Near the northeast corner of section 13 a stream of good water, twenty links wide, crosses the easterly boundary and flows westerly. The soil throughout is black loam, clay and sandy subsoil and is well adapted for agricultural purposes. Kamsack is the nearest railway station to this township.—*W. J. Deans, D.L.S., 1907.*

TOWNSHIPS WEST OF THE SECOND MERIDIAN.

Range 1.

21. The surface of the township is rolling and the soil a rich black loam with clay subsoil. The township is covered with a growth of small poplar and willow scrub, except the southerly part which is open prairie with clumps of willow and poplar scrub. No trees large enough for building purposes were seen but there is an abundance of fuel for many years. Cutarm creek, a stream of good water, about twenty feet wide, enters the township on section 35 and flowing southerly leaves it on section 24. The valley of this stream varies in width from one-quarter to one-half mile with banks about eighty feet high. There are many fine hay meadows in the valley of Cutarm creek, but the settlers complain that the beaver, which are multiplying very fast, destroy the hay land by damming the creek and flooding the land. This township was settled many years ago as it was expected that the main line of the Canadian Pacific railway would pass through it. Few of the old settlers remain, having become discouraged through want of railway facilities. There are no minerals to be seen, although springs along Cutarm creek seem to be highly impregnated with iron. There are no stone quarries nor water-powers. The settlers are engaged in grain growing and dairying and appear to be successful and prosperous. Esterhazy on the Pheasant Hills branch of the Canadian Pacific railway is the nearest station to the south part of the township, and Bredenbury is the nearest station for settlers residing in the north part. There are good roads leading to the various villages on the railways.—*W. J. Deans, D.L.S., 1907.*

TOWNSHIPS WEST OF THE SECOND MERIDIAN.

Range 1—Continued.

38. The soil of this township is a black loam with a subsoil of clay or sand and if not for the early frost would be good for farming, especially the growing of fall wheat, The timber is mostly poplar and spruce, varying from eight to twenty-four inches in diameter, chiefly in the northwestern sections and scrubby to the east side. There are numerous small sloughs of hay of a good quality and good for cattle, but the horses do not thrive on it. One large slough just north of the four-mile chord extends well across the township. Plenty of fresh water is found in small creeks and can be had easily by digging, especially in the swampy districts. There are no creeks or rivers that would do for water-power. The climate is variable from hot day to cold nights, and we had frosts that froze water in July, and also frequent rains. Plenty of fuel, consisting of spruce and poplar is found. There are no stone quarries or minerals and little stone except near a creek and then only boulders. There seemed to be plenty of jumping deer, moose, bear, partridge and duck, and sometimes traces of wolves and mink were found.—*Edgar Bray, D.L.S., 1908.*

Range 2.

38. After leaving Fort Pelly, Saskatchewan, we travelled in a northwesterly direction and followed the valley of Swan river up to Bear creek where we camped. As no road or trail was yet cut we had to do this ourselves. The soil in this township is a black loam with a sandy or clay subsoil and once in a while gravel or clay. If there were no early frosts it would be suitable for mixed farming. The township as a whole is rolling and timbered more heavily in the eastern side next Swan river with spruce and poplar ranging from eight to thirty inches in diameter, with underbrush. On the western side is more of a muskeg nature, and the timber is in bluffs and of a scrubby nature. There are plenty of small fresh water streams, but many get very low in the summer season and very high during spring and fall. In the southwest corner near Goose lake there are many hay sloughs with abundance of hay which would be suitable for ranching. No water-powers are available as the streams are too sluggish and unreliable. Warm days, cool nights, early and late frosts predominate, but this will likely change as the country is settled. Wood fuel abounds, but no coal, minerals or stone quarries were found. Plenty of game, such as moose, jumping deer, bear, mink, wolves, coyotes, duck and geese were noticed.—*Edgar Bray, D.L.S., 1908.*

Range 3.

38. This township was reached from township 38, range 2, along the Nut lake Indian trail which had to be cut so as to get the wagons through. We were unable to get any farther north than the two-mile chord, owing to the swampy nature of the country. The township is wooded in the south with poplar, spruce from six to eighteen inches in diameter, and scrub, and is rolling, but in the northern part it is more level and the timber nearly all spruce of the same dimensions. Numerous hay sloughs are scattered throughout the township and also small streams and ponds. It would make good ranching land. There are no water-powers as the streams are too small and nearly dry up during the summer season. Summer frosts prevail. Only wood fuel was found. No stone quarries or mineral veins were noticed. Game, such as moose, jumping deer, bear, wolves, coyotes, duck, geese and mink are plentiful.—*Edgar Bray, D.L.S., 1908.*

Range 5.

37. The route to this township begins at Canora on the Canadian Northern railway and runs in a northwesterly direction, passing by Astwood postoffice along a good

Range 5—Continued.

trail to Fulton's mill in township 38, range 5, through the centre of this township. The soil is very good though in places very stony and is suitable for farming. The easterly half of section 4, the southwesterly quarter of section 5, the east half of the westerly quarters of section 9, a small fraction of the easterly half of sections 21 and 28 and the westerly half of section 33 are prairie lands. Section 6 is timbered with white poplar, four to ten inches in diameter, and the remainder of the township is scrubby. The only timber is on section 6 and varies in diameter from four to ten inches, suitable only for building logs or fuel. There is a good supply of upland hay on the prairie and considerable slough hay in the Etoimami river valley, and good hay sloughs are spread over the township. There is a sufficient and permanent supply of good fresh water. The only stream of any size in the South Etoimami river which rises in South Etoimami lake in sections 33 and 34, township 37. It has an average width of thirty feet, depth of three feet and a strong current and flows the year round. There are no waterfalls in this township. The climate is colder than most of the older sections of southern Saskatchewan but should moderate as the land is cleared. Summer frosts were numerous and occurred in every month of the past summer. Wood is the only available fuel and white poplar fit for fuel is spread over the township, except on the prairie. There are no stone quarries or minerals of any kind in this township. Jumping deer, moose, duck and partridge are the only game and were very scarce during last season.—*C. A. Chilver, D.L.S., 1907.*

Range 9.

32. This township is easily reached by a good trail running southerly from Invermay, a station on the Canadian Northern railway. The soil in this township is a black loam with a clay subsoil and is suitable for grain growing and mixed farming. The surface is rolling and covered with scrub and poplar. The poplar which averages about six inches in diameter is principally around a large salt lake which occupies the northern part of the township. Large quantities of wood are cut in the township and shipped west for fuel. There are large quantites of hay around the lakes and sloughs in the township. The water in the lakes and sloughs is salty but horses and cattle seem to thrive on it. There is a small stream enters the salt lake near the northeast corner of section 34 and runs out of the lake near the southeast corner. There are no water-powers, stone quarries or minerals of any kind in the township. The climate is good and free from summer frosts. Game such as wild duck, is plentiful and occasionally jumping deer and moose are seen. There is a good market for farm produce at Invermay which is close to the township.—*W. J. Deans, D.L.S., 1907.*

42. There is no good road into this township, though there is an Indian pack trail from the vicinity of Nut lake running through it. We cut a trail from Mistatim which would only be of service in winter as it crossed many sloughs and marshes. The surface of the township varies from nearly level to almost hilly and is nearly everywhere covered by a heavy second growth of poplar, the older forests having apparently been burned. The soil is rich and strong and should be well suited for all kinds of farming. No timber of value was seen though the larger poplar and a few scattered spruce and tamarack might supply the needs of settlers for a time. Hay appeared to be abundant on the uplands and in many small sloughs and larger marshes throughout the township. Water is plentiful. One of the drawbacks to this part of the country is the excess of water, but this township though having many sloughs had also plenty of fine high land. No water-powers, economic minerals or game were seen. Copeau river flows across the township in a narrow and not very

Range 9—Continued.

deep gully, well lined with willows. This gully is probably flooded in the spring, though at the time of the survey (February) the river was quite small. The water in it is excellent and though no water-powers were seen the current is very good. This township should prove good for settlement when made accessible by fair roads.—*Geo. A. Grover, D.L.S., 1907.*

43. This township was reached by a trail from Mistatim which we cut, but it could be used only in winter as it crossed many sloughs and ponds. I was informed by some lumbermen that there is also a lumber trail from Bannock to the north side of this township. The surface is very nearly level and the soil is generally a black loam on clay that should raise excellent crops. In the centre of the township there are several large marshes or muskegs, apparently not very deep, as they were generally covered with vegetation and frequently we were unable to get water in such places after digging through the frost. The township has evidently been burned over in the past and is now chiefly covered with second-growth poplar of two to three inches in diameter. There is, however, a certain amount of large timber consisting of spruce, tamarack and poplar scattered over the township and to the north of Red Deer river there is considerable spruce of some size which I understand is already claimed by the lumber companies. There is plenty of wood for both fuel and building for settlers for many years. Numerous small hay sloughs and the larger marshes should make hay and water abundant, and there is also good forage for cattle among the trees. Red Deer and Copeau rivers both cross parts of this township; the former, a considerable stream sixty to eighty feet wide, was frozen over at the time of survey (February) but I judge it would be about three feet deep and have a current of two or three miles per hour. The Copeau is only a good sized creek, but at flood time might be quite formidable. There were no economic minerals, game or water-powers seen. The township should be good for settlement when means of communication are established, though there are at present no settlers in that vicinity.—*Geo. A. Grover, D.L.S., 1907.*

Range 10.

41. (East outline). This township though broken by hills in the southwesterly part and heavily wooded should prove a good one for settlement when the timber has been taken off, as the soil is obviously strong and fertile and it is well drained by numerous creeks.—*Geo. A. Grover, D.L.S., 1907.*

42. There is no wagon trail into this township, but there is a good wagon trail to the northwest corner of township 42, range 11, from Crooked River station, on the Canadian Northern railway, from which it would be comparatively easy to get into this township, either with pack horses or even with a wagon. The soil is somewhat light, consisting of a sandy loam, but supports a good natural growth in most places and is suitable for grain growing or mixed farming, since much of it could be easily cleared. The surface is undulating or easily rolling except in sections 15, 16, 17 and 21, where it is somewhat broken, and covered for the most part with poplar and willow scrub, with occasional bluffs of poplar or spruce timber. There are numerous small prairies, and some sloughs, on which hay of good quality could be cut, but there are no important hay meadows. There are scattered bluffs of spruce and tamarack throughout the township which though unimportant in extent from a lumberman's point of view, will be of great value to incoming settlers. Red Deer river furnishes an excellent and permanent supply of fresh water in this township. It flows through the township in a northeasterly direction from section 18 to section 33. There is a tributary creek which enters the township in section 6 and flows into Red Deer river in section

Range 10—Continued.

28. Red Deer river has an average width of seventy feet, is from two to six feet deep, has a current of about two miles per hour and flows through a marshy valley about a quarter of a mile wide with banks from twenty to seventy feet high. The tributary creek referred to above is ten feet wide, has a gravel bottom, is two feet deep and flows about two miles per hour. It is probably spring-fed, since it remained open in most places all winter. The only part of this township liable to be flooded is the bottom land of the Red Deer. There are no water-powers in this township and no indications of coal, stone or minerals. Moose, deer, bear and lynx are found throughout this district, and there are fish in Red Deer river. There is a good average rainfall throughout this section of the country and the danger from summer frosts is, as elsewhere in the province, constantly decreasing. There are no settlers in this township.—*R. W. Cautley, D.L.S., 1907.*

43. This township is at present accessible only in winter by trails cut by lumbermen to the north and those which I have cut into the centre of the township. It is not, however, far from the Canadian Northern railway and with the advent of settler's trails can doubtless be easily made. The township is most suitable for settlement, the soil being strong and rich and the surface almost generally level with just enough slope to ensure drainage. There is, however, a pretty heavy growth of young poplar throughout the township. In sections 28, 29, 30, 31, 32 and 33 there is a very good timber limit, spruce three to four feet in diameter being seen. Throughout the township there is an abundance of wood for fuel and building, and the water supply is permanent and plentiful. Red Deer river pursues a tortuous course through the southeast corner of the township. It is about fifty to seventy-five feet in width, two feet deep, and runs about three miles an hour. There were no settlers at the time of survey. No game, economic minerals nor water-powers were seen. The only drawback to the township is the bush and difficulty of access.—*Geo. A. Grover, D.L.S., 1907.*

Range 11.

41. (East outline). This township is largely covered by Greenwater lake, to the south and east of which it is heavily rolling or hilly country, covered with large poplar and spruce, several timber limits being noticed in this vicinity. The soil is good and there is a bountiful supply of good water in the streams and little ponds. It is a good hunting country, evidence of bear, moose, deer and smaller game being seen. To the northeast this township is less hilly and not so heavily wooded.—*Geo. A. Grover, D.L.S., 1907...*

42. This township is reached by a good wagon trail from Crooked river, on the Canadian Northern railway, which touches it at section 31. The surface is undulating and covered for the most part with poplar and willow scrub, although patches of spruce and tamarack occur in sections 4, 5, 6, 11, 31, 32, 33 and 34, while there are also patches of open prairie throughout; the soil is perhaps best classified as second class, consisting of a light sandy loam, which however, would yield an early maturing crop, an advantage which is of great importance in a country where summer frosts sometimes do great damage. I consider that more than half of this township is suitable for grain growing. Hay could be cut on some of the open spots of prairie, but there are no hay meadows of any size. Red Deer river, which flows through this township from west to east, is an extraordinarily crooked stream with, however, a very even, clear channel of about seventy feet in width; it varies in depth from two to six feet and affords a constant supply of good water both in summer and winter. I saw no indications of minerals, stone suitable for quarrying, or coal deposits and there is no avail-

Range 11—Continued.

able water-power in this township. Moose, jumping deer, black bear, lynx and prairie-chicken are found throughout this district and there are fish in Red Deer river. There are no settlers in this township.—*R. W. Cautley, D.L.S., 1907.*

43. This township can be reached by a fair trail from Crooked river, a small station on the Prince Albert branch of the Canadian Northern railway. This trail in wet seasons is very soft in places, and following as it does many sidehills, is rather a difficult one to travel. The soil is generally a fine black loam on clay soil and would make good farming land. The surface of the township is slightly undulating and covered with bush of various kinds. Bjork lake, so named from the first settler in the neighbourhood, is a large shallow body of water that takes up much of the eastern part of the township. The shores of the lake were often marshy and both on the north and south sides are large spruce swamps. The westerly part of the township is more open, the surface being covered with poplar and willow which in places leave spots of almost clear land; this has brought in several settlers. There is some fair spruce timber up to twenty inches and large poplar up to fifteen inches in the north and south ends of the township and about the lake, though I do not think it would be sufficient for a profitable limit. It will, however, be ample for the settlers for many years to come for all classes of building. As the survey was made in winter (February) it was difficult to judge of hay and water but I should judge that both would be in fair quantity. No water-powers, minerals of value, game nor fuel other than wood, were seen. Settlement in this township has already made a good start, but owing to the large lake and neighbouring swamps, settlement will probably be slower than in the townships farther east where roads are opened up.—*Geo. A. Grover, D.L.S., 1907.*

Range 14.

50. This township lies six miles due east from Lost River postoffice and can be reached from there by a good wagon trail entering section 7, a distance by trail of eight miles. The soil is composed of black and sandy loam averaging six inches in depth, with a clay subsoil. With the exception of quarter sections broken by the river and muskegs the whole township should be well adapted for the growth of grain. In all probability a couple of spring fires in succession would clear most of the land. The surface, speaking generally, is brulé poplar and willow scrub, and a dense undergrowth of weeds interspersed with occasional bluffs of poplar from four to eight inches in diameter. A quantity of spruce running up to twelve inches will be found on the east bank of the Saskatchewan river, in sections 18, 19, 30 and 31. With a small portable mill here the settlers could obtain all the lumber required in this vicinity for a long time. There is very little hay at present, except in dry years when hay of a second quality could be obtained from muskegs. Saskatchewan river enters this township in section 18, flows north and leaves from section 31. The banks run from one hundred and fifty to two hundred and fifty feet high. Nipawin rapids end in section 18. There is no water-power on this portion of the river. A long muskeg averaging about ten chains in width starts in section 17, extending northeast and leaving the township in section 36. A winter mail route from Fort a la Corne to Cumberland House runs along this muskeg. The southeast corner of this township is principally a willow swale and liable to flood; the remainder is high and free from flooding. The climate this summer was mild and clear, except a heavy rainfall in June. The first frost was noticed on August 13, but was not severe enough to affect the grain. Dead wood in abundance can be obtained for fuel. No coal or minerals were seen. Stone can be found along the river. Moose, bear, partridge and fish were found.—*R. H. Montgomery, D.L.S., 1908.*

TOWNSHIPS WEST OF THE SECOND MERIDIAN.

Range 14—Continued.

51. This township lies about eight miles northeasterly from Lost River postoffice and can be reached by a good wagon trail from there running due east to range 14, thence northeasterly, entering this township in section 3, a distance by trail of fifteen miles. The soil is a sandy loam, averaging eighteen inches, with a sand subsoil, and should be adapted in portions for mixed farming. The surface is wooded, the western third and southeasterly corner being covered principally with poplar and willow scrub, the remainder with poplar, jackpine, spruce and tamarack running from four to eight inches. The only timber is a small grove of spruce, from eighteen to twenty-four inches, situated at the northeast corner of section 35, too small to be of any value. There are no hay sloughs. Saskatchewan river, with a width varying from fifteen to twenty-five chains, and a current from two and one-half to six miles per hour, enters on section 5 and leaves from section 36. Its valley has a depth varying from seventy-five to two hundred feet. Several small creeks flow into it. A large muskeg lies in the centre of the northern portion of this township, while another is situated on sections 7, 18 and 19. All water is fresh and clear. There are no water-powers. The climate this summer was mild and clear; a heavy rainfall occurred in June, the first summer frost being noticed on August 13. Dead wood in abundance can be obtained for fuel. No coal or minerals were found. Stone can be obtained from Saskatchewan river. Moose, bear, partridge and fish were seen.—*R. H. Montgomery, D.L.S., 1908.*

52. This township can be reached from Lost River postoffice by a wagon trail running east to the centre of township 50, range 14, thence north crossing Saskatchewan river on section 15, thence west to the east boundary of township 51, range 15, thence north entering this township on section 6. This trail, about twenty-two miles long, is in fair condition. The soil is a black and sandy loam, averaging from twelve to eighteen inches, with a clay subsoil, and should be well adapted for mixed farming. The surface is entirely wooded being covered principally with poplar and willow scrub. Poplar, balm of Gilead, spruce, tamarack, jackpine, birch and balsam averaging from four to eight inches are all to be found in this township. On section 12 a small quantity of spruce, the only timber seen, will be found running up to twenty-four inches. There are no hay sloughs. Torch river, a stream about one hundred and seventy-five feet wide, nine feet deep, with a current of two miles per hour, enters on the west boundary of section 31, flows east, and leaves on the north boundary of section 33. Whitefox river, a stream about one hundred and five feet wide, eight feet deep, with a current of three miles an hour, enters on the east boundary of section 30, flows east and north and empties into Torch river at the northeast corner of section 32. Saskatchewan river flows northeast through sections 1 and 12. There are no water-powers. The climate this year was mild and clear, though a heavy rainfall occurred in June, the first frost being noticed on August 13. No coal, stone quarries or minerals were to be seen. Moose, bear and fish were noticed.—*R. H. Montgomery, D.L.S., 1908.*

Range 15.

41. There is a good road from Melfort on the Canadian Northern railway to Nut lake which passes through the north tier of sections of this township. The soil is second class consisting of black loam on clay and gravel subsoil and is stony in places; it is suitable for mixed farming. The surface is gently rolling and is generally timbered except in the north part, where sections 32, 33, 34 and 25 are mostly open. There are small patches of prairie throughout the township. The timber is chiefly poplar scrub with occasional bluffs of poplar from four to eight inches in diameter, and a few spruce and tamarack along Barrier river. A small quantity of hay may be cut on the prairie land in sections 32, 33, 34 and 25 and also along the valley of Barrier

river in sections 27, 35 and 36. The township is well watered by the Barrier and four permanent lakes. This river flows through Otter lake in sections 30, 29 and 28 and thence through sections 27, 34, 35 and 36; it is about seventy feet wide, six feet deep, has a current of two miles per hour and lies in a well defined valley about half a mile wide and one hundred and twenty feet deep. The water is fresh and there is no land liable to be flooded except the bottom land of the river. Thre are no water-powers. Wood is available for fuel for the use of settlers, but there is no evidence of the existence of coal seams, quarrying stone or minerals. The climate in this district has a good average rainfall and the danger to crops from summer frosts is generally inappreciable. Moose, elk, deer, bear and lynx are still fairly plentiful in this region, and there are several kinds of fish in Otter lake and Barrier river.—*R. W. Cautley, D.L.S., 1907.*

51. This township lies about five miles due north from Lost River postoffice. It can be reached by a wagon trail running east from Lost River to the centre of township 50, range 14, thence north crossing Saskatchewan river in township 51, range 14, thence west entering this township in section 25, in all a distance of about twenty-one miles. This trail is in fair condition. The soil is a black loam, running from six to twelve inches with a clay subsoil, and should be suitable for mixed farming. The surface is entirely wooded. The portion north of Whitefox river consists of poplar four to twelve inches, balm of Gilead of the same size, spruce four to fourteen inches with willow, poplar, alder and hazel scrub, while south of the river there is poplar, balm of Gilead and spruce, four to eight inches and tamarack three to six inches with scrub. Windfall is very plentiful all over this township but there is no timber except for the settlers' use. There are no hay sloughs. Whitefox river enters in section 30, flowing east to section 23, thence north leaving from section 35. It is a stream about eighty-five feet wide, five feet deep, has a current of four miles per hour and runs in a valley about seventy feet deep. There are numerous small creeks all over this township, preventing any flooding of the land but no water-powers. A large muskeg lies in sections 23, 13 and 12. The climate was mild and clear except a rather heavy rainfall in June. The first summer frost was noticed on August 13. Deadfall in abundance can be obtained for fuel but no coal or minerals were found. Stones can be obtained in Whitefox river. Moose, bear, partridge and fish were to be seen.—*R. H. Montgomery, D.L.S.*, 1908.

52. This township can be reached by a fairly good wagon trail from Lost River postoffice running east to the centre of township 50, range 14, thence north crossing Saskatchewan river on section 15, in township 51, range 14, thence east to the east boundary of township 51, range 15, thence north entering this township on section 1. On the north one-third of this township the soil is sand. The western half of the remaining portion is composed of heavy tough clay, while the remainder consists of black or sandy loam, averaging twelve inches, with clay subsoil. This portion should be suitable for mixed farming. This township is entirely wooded. The northern one-third is covered with jackpine running two to eight inches. The western part is covered with spruce up to eighteen inches, poplar to fourteen inches, balm of Gilead to fourteen inches, with dense growth of hazel. The eastern portion is covered with poplar and willow scrub interspersed with poplar, balm of Gilead and spruce averaging from six to fourteen inches. Spruce up to eighteen inches, poplar and balm of Gilead up to fourteen inches can be found scattered all over the township particularly in the western half. This could all be used as timber. There are no hay sloughs. Torch river, a stream about one hundred and seventy-five feet wide, nine feet deep, with a current of two miles per hour, enters and leaves this township on section 36, flowing

Range 15—Continued.

east. Whitefox river, a stream about one hundred feet wide, four feet deep, with a current of four miles per hour, enters on the south of section 2, flows north, then east, leaving from section 25. Fern creek, a stream ten feet wide, one foot deep, with a current one and one-half miles per hour, enters on section 31, flows southeast, emptying into Whitefox river on section 23. There are no hay sloughs. The climate this year was mild and clear, although a rather heavy rainfall occurred in June, the first summer frost being noticed on August 13. No water-powers were found, and no coal, minerals or stone quarries were seen. Moose, bear and fish were seen.—*R. H. Montgomery, D.L.S., 1908.*

Range 16.

41. No wagon road enters this township at the present time but there is a good wagon road from Melfort, on the Canadian Northern railway, to Nut lake, which passes within ten chains of the northeast corner of the township and a branch road from it to the head of Otter lake, from which point the township may be reached by a boat or by a pack trail which runs south almost directly through the centre of the township. The soil is a light loam containing a great many stones and boulders in many places, but most of the four south tiers of sections, is capable of being farmed. The surface is gently rolling and heavily timbered throughout with poplar, balm of Gilead and dense underbrush. There are some bluffs of valuable spruce timber in sections 21, 27 and 28, and all the rest of the township is covered with poplar and balm of Gilead of such size that it will probably become valuable for milling purposes as soon as all the spruce in the vicinity has been cut. There is very little hay in this township except in marshes adjacent to some of the numerous lakes. The township is abundantly watered by a number of permanent lakes. Of these Otter lake, through which Barrier river flows from west to east, is the largest; it is surrounded by steep hills from eighty to one hundred and twenty feet high, is very deep and contains good water; all the other lakes contain water that is fresh but has a somewhat marshy taste. A tributary of the Barrier, flows northerly through several of the lakes and connecting marshes; it has a very sluggish current and has the nature of a slough creek. There are no available water-powers in this township. The climate of the surrounding country has a good rainfall, and the danger to crops from summer frost is generally inappreciable. There is an almost inexhaustible supply of wood fuel, but I saw no sign of the presence of coal, quarrying stone or minerals. Moose, elk, deer, bear and lynx are still fairly plentiful throughout this region. The numerous lakes and marshes give excellent feeding grounds for geese and ducks, and there are several varieties of coarse fish in the lakes.—*R. W. Cautley, D.L.S., 1907.*

42. This township is reached by a good wagon road from Melfort on the Canadian Northern railway, to Nut lake, which enters the township in section 32 and leaves it at the southeast corner. Kinistino Indian reserve No. 91 occupies fifteen square miles of this township including the northerly half of sections 1, 2, 3, 4, and 5, all of sections 8, 9, 10, 11, 12, 13, 14, 15, 16 and 17 and the southerly half of sections 20, 21, 22, 23 and 24. The soil is very good in the northerly two and one-half tiers of sections, consisting of black loam on clay and gravel subsoil but is very stony and therefore second class, although suitable for grain growing or mixed farming; the land along the south and west boundaries of the township is so stony that it is hardly fit for agriculture, although the soil is of very fair quality. The surface is gently rolling and covered with heavy poplar, balm and dense underbrush along the south and west boundaries of the township while the two and a half northerly tiers of sections are covered with poplar and willow scrub alternating with very considerable tracts of open

Range 16—Continued.

prairie. There is a saw-mill in operation on the reserve, and, although there is practically no spruce timber of any value on that part of the township surveyed by me, there is a good deal of poplar from ten to sixteen inches in diameter along the south and west boundaries of the township which will be of value for milling as soon as all the spruce in the vicinity has been cut. Small hay meadows occur throughout the township, and in the northerly part of it, upland hay may be cut on the prairies. There is a permanent supply of fresh water afforded by Barrier river, Fish creek, Leather river and seven lakes. Barrier river is about seventy feet wide, two feet deep, has a current of about two miles per hour and flows through a well defined valley from forty to eighty feet deep. Fish creek is about forty feet wide, one foot deep, has a current of two miles an hour and flows into the Barrier within the boundaries of the reserve. Leather river is a small but permanent stream flowing north and draining the northeasterly part of the township. None of this township is liable to flood and there are no natural water-powers although it would be possible to dam the Barrier at its exit from Kwatapiu lake, using the lake as a reservoir, and thus create a serviceable power. There is a good average rainfall in this part of the country and the danger to crops from summer frosts is very slight. I saw no evidence of the presence of minerals, quarrying stone or coal, but there is an abundance of wood available for fuel. Moose, elk, deer, bear and lynx are still very plentiful in this region and there are several varieties of coarse fish in the Barrier and lakes through which it passes. There are already several settlers in the township and there is every indication that all of the northerly part of it will be taken up within the next year or two.—*R. W. Cautley, D.L.S., 1907.*

51. This township lies about forty miles northeasterly by trail from Fort a la Corne. This trail runs due north from Saskatchewan river to township 50, thence northeasterly entering this township in section 19. It is in fair condition. The soil consists of a black and sandy loam with a clay subsoil and should be suitable for mixed farming. The surface is entirely covered with bush and scrub. The northern portion is covered principally with poplar and willow scrub, while the southern portion is covered with poplar, spruce and tamarack, averaging four to eight inches, interspersed with scrub. There is no timber nor hay sloughs. Whitefox river enters this township in section 19 and leaves from section 25. It has a width of about ninety feet, a depth of four feet and a current varying from two to five miles an hour. The valley is from seventy-five to one hundred feet deep. Kelsey creek flows south through sections 32 and 29 into Whitefox river. It is ten feet wide, two feet deep with a current of two miles per hour. Two large lakes lie to the south of this township, both having muskeg shores. There are no water-powers, neither are coal, or minerals to be found, but there are plenty of stones in the river. Moose, deer, bear, partridge and fish were to be seen.—*R. H. Montgomery, D.L.S., 1908.*

Range 17.

41. There is a rough wagon trail to Watson from Melfort on the Canadian Northern railway which passes through the most westerly tier of sections in this township. The soil is mostly second class, consisting of black loam on a clay subsoil, but in the two westerly tiers of sections the soil is much deeper and well adapted for mixed farming. The surface is gently rolling and covered throughout with poplar and willow. There is some land in the southwest corner of the township on which it would be possible to cut a certain amount of hay. The township is abundantly watered by twelve permanent fresh water lakes, which are all somewhat marshy with the exception of the lake in section 31, which I was informed, is very deep and in which the water is always

Range 17—Continued.

cold and good. No land is liable to be flooded and there are no water-powers available. There is plenty of wood for fuel for many years, but I saw no evidence of the existence of coal seams, quarrying stone or minerals. The climate is good, this part of the country being well north of the dry area and most suitable for grain growing. Moose, elk, deer, bear and lynx are still fairly plentiful in this district.—*R. W. Cautley, D.L.S., 1907.*

50. This township lies about twenty-nine miles northeasterly from Fort a la Corne by trail. This trail runs due north from Saskatchewan river to township 50, range 20, thence easterly entering this township in section 30. It is in fair condition but rather hilly near the river. The soil on the northern half is principally sand; on the southern portion it is composed of black and sandy loam, suitable for mixed farming. The surface is entirely wooded, consisting of jackpine, poplar, spruce and tamarack bush, with poplar, jackpine and willow scrub. Jackpine and spruce up to sixteen inches can be found all over the township, but not in sufficient quantities for lumbering purposes, although a portion could be used for ties. No large hay sloughs were found. There are numerous muskegs in this township, and a few small creeks affording an ample supply of good water. There is no danger of floods. No water-power is available. The climate last fall was warm and clear, with little rain. The first frost was noticed on August 20. Dead wood in abundance can be obtained for fuel. No coal, stone or minerals were found. Moose, jumping deer and partridge were seen.—*R. H. Montgomery, D.L.S., 1907.*

51. This township lies about thirty miles northeasterly by trail from Fort a la Corne. This wagon trail runs due north from Saskatchewan river to township 50, thence northerly, entering this township in section 19. This trail is in fair condition but is inclined to be hilly near the river. The soil is a black and sandy loam and should be suitable for mixed farming. This township is covered with bush, consisting of poplar, balm of Gilead, jackpine, spruce and tamarack. The south two tiers of sections are chiefly muskeg; north of this to Whitefox river there is light poplar and willow, while north of the river heavier poplar and balm of Gilead are to be found. Along the Whitefox and north of it, there is spruce, poplar and balm of Gilead up to sixteen inches but not in large quantities. Practically speaking, there is no timber in this township. There are no hay sloughs, Whitefox river crosses this township entering in section 19 and leaving from section 24. It has a width of about one hundred feet, a depth of six feet, a current of about three and one half miles per hour and runs in a valley forty feet deep. Several small creeks drain into it. Large muskegs lay across the southern part of the township. All the water is good. No water-power occurs. The climate was mild this spring and heavy rain fell in June. July was very hot. Dead wood in abundance can be obtained for fuel, but no mineral, coal or stone were to be seen. Moose, deer, bear and partridge were seen. Fish, principally jackfish and mullet are found in Whitefox river.—*R. H. Montgomery, D.L.S., 1908.*

Range 18.

50. This township lies about twenty-two miles by trail northeasterly from Fort a la Corne. This trail enters the township in section 19; it is in fair condition but rather hilly near Saskatchewan river. The soil is composed of sand with belts of black and sandy loam. A portion of it is suitable for mixed farming. The surface is covered with jackpine, poplar, spruce and tamarack bush, with jackpine, poplar and willow scrub. Jackpine up to sixteen inches can be found scattered throughout the township but not of sufficient quantities for lumbering purposes. No large hay sloughs were seen. Several small creeks drain this township. One large muskeg extends nearly

Range 18—Continued.

across the entire north boundary. The water is all of good quality and no danger is liable to be caused by flooding. There is no water-power. The climate this fall has been mild, clear and open, the first frost being noticed on August 20. Dead wood in abundance can be obtained for fuel. No coal, stone, or minerals were found. Moose, jumping deer, and partridge were seen.—*R. H. Montgomery, D.L.S., 1907.*

51. This township lies about twenty-seven miles by trail northeasterly from Fort a la Corne. A wagon trail runs due north from Saskatchewan river for ten miles, thence northeast entering this township in section 4. This trail is in fair condition but inclined to be hilly near the river. The soil is principally a black or sandy loam, averaging about eighteen inches, with a clay subsoil and would be suitable for mixed farming. The surface is wooded, being covered with poplar, balm of Gilead, spruce, tamarack and jackpine with willow scrub. There is no timber nor hay sloughs in this township. Numerous creeks are to be found all over the township, while large muskegs are scattered in the south. Whitefox river enters this township on section 19 and leaves it from section 24; it is about fifty feet wide, ten feet deep, with a current of about four miles an hour. Bisset creek is about thirty-five feet wide, eight feet deep, and has a current about three miles per hour. There is no water-power available. The climate was mild and fine except for a rather heavy rainfall in June. Deadwood in abundance can be obtained for fuel, but no stone, or minerals were to be found. Moose, deer, and bear were seen.—*R. H. Montgomery, D.L.S., 1908.*

Range 19.

1. This township is most readily reached from Weyburn by taking what is known as the 'French' trail as far as a country store in township 5, thence a trail to the police barracks as far as township 3 and thence going across country. The trail is a good one as far as the store, except in the spring. Beyond there it is little more than a track and hard to follow. There is an old Indian trail crossing this township leading in the direction of Weyburn. The soil is a clay loam with a hard clay subsoil. There is considerable gravel in places and alkali on the low ground. The soil might be suitable for crop raising, but the entire township with the exception of a few quarter sections is much too hilly. No timber or scrub of any kind grows in this township. Hay is very scarce as there are very few hay sloughs, particularly south of the large lakes. There are two large lakes and one somewhat smaller in this township, but they are all extremely salty. A few springs along their shores is about the only fresh water to be found. A very small stream flows into the westerly lake from the north but it is rather alkaline and dry for most of the summer. There are no water-powers. The climate is very dry. No summer frosts were noticed but there were late spring and early fall frosts. The winters are reported to be severe but stock can winter out without protection. There is no fuel in the township unless there are underlying seams of lignite, but lignite is available in township 1, range 22. No stone quarries or minerals were noticed. A few antelope and duck were seen.—*I. J. Steele, D.L.S., 1908.*

4. This township is most readily reached from Weyburn by taking what is known as the 'French' trail as far as township 5, range 19, thence a trail to the police barracks which passes through this township. The trail is a good one as far as township 5, range 19, except in the spring. Beyond there it is only a track and is difficult to follow. The soil is a clay loam with a clay subsoil. There is some gravel in places. The soil would be suitable for crop raising but the whole township with the exception of a few quarter sections is much too hilly. No timber or scrub of any kind grows in the township. There is considerable hay of fair quality as there are a great many

Range 19—Continued.

hay sloughs in every part of the township. These sloughs together with a few small lakes furnish a good supply of fresh water. There are no streams and consequently no water-powers. The climate is inclined to be dry but not so dry as a little farther west. No summer frosts were noticed but there were late spring and early fall frosts. The winters are reported to be severe but stock is able to winter out without protection. No fuel whatever was found in this township but coal is available in township 3, range 21. No stone quarries or minerals were noticed. A few antelope and duck were seen.—*I. J. Steele, D.L.S., 1908.*

50. This township lies about fourteen miles northeast by trail from Fort a la Corne, and can be reached by trail running to township 50, range 20, thence due east entering the township in section 5. The condition of this trail is fair, though somewhat hilly near Saskatchewan river. The soil is generally sand with a few belts of black and sandy loam. The surface is covered with jackpine, poplar, spruce, and tamarack bush and with jackpine, poplar, and willow scrub. Jackpine, up to sixteen inches, can be found scattered all over the township, but of little value for lumbering. There are a few hay sloughs where second class hay can be obtained. There is plenty of good water to be found in ponds and muskegs, in all parts of the township, except the south-eastern portion. English creek is a stream of good water, being about ten feet wide and two feet deep, and has banks about sixty feet high. There is no danger of floods. No water-power is available. The climate this summer was cool and damp, the first frost occurring on August 20. Dead wood in abunadance can be obtained for fuel all over the township. No stone, coal, or minerals, were found. Moose, jumping deer, and partridge were seen.—*R. H. Montgomery, D.L.S., 1907.*

Range 20.

1. This township is most readily reached from Weyburn by taking what is known as the 'French' trail as far as township 5, range 19, and thence a trail to the police barracks which passes through this township. This trail is good as far as township 5, range 19, except in the spring. Beyond there it is little more than a track and is hard to follow. The soil is a clay loam with a clay subsoil. There is considerable gravel in places and alkali in the low ground. It might be suitable for crop raising but most of the township is much too hilly, only a few sections in the western part being sufficiently level. Hay is not very plentiful as there are few hay sloughs. These sloughs together with a few springs in the creek valley and along the lake shore, furnish a very limited supply of fresh water. The creek itself is rather alkaline, and dry during most of the summer. The lake in the easterly part of the township is too alkaline to be of any use. The climate is very dry. The grass in this township quit growing and matured early in July. No summer frosts were noticed but there are late spring and early fall frosts. The winters are reported to be severe but stock is able to winter out without protection. No fuel, whatever, was found in this township but coal is available in township 1, range 22. No stone quarries or minerals were noticed. A few antelope and deer were seen.—*I. J. Steele, D.L.S., 1908.*

2. This township is most readily reached from Weyburn by taking what is known as the 'French' trail as far as township 5, range 19, thence a trail to the police barracks passing through this township. This trail is good as far as township 5, range 19, except in the spring. Beyond there it is little more than a track and hard to follow. The soil is a clay loam with a clay subsoil. There is considerable gravel in places, and alkali on the low ground. The soil in places might be suitable for crop raising but the entire township is much too hilly. No timber or scrub of any kind grows in the township. Very few hay sloughs are found in the township but there

Range 20—Continued.

is considerable hay of fair quality in the creek valley. These sloughs furnish the only supply of fresh water. The creek running through the township is slightly alkaline and is dry most of the summer. The lake in section 18 is also alkaline. There are no water-powers on the creek. The climate is very dry. No summer frosts were noticed but there were late spring and early fall frosts. The winters are reported to be severe but stock can winter out without protection. There is no fuel whatever in the township unless there are underlying seams of coal, but coal is available in township 3, range 21. No stone quarries or minerals were found. A few antelope and duck were seen in this township.—*I. J. Steele, D.L.S., 1908.*

3. This township is most readily reached from Weyburn by taking what is known as the 'French trail as far as a country store in township 5, range 19, from there a trail to the police barracks as far as township 3, range 19 and thence across country. This trail is a good one as far as the store, except in the spring. Beyond there it is little more than a track and hard to follow. The soil is a clay loam with a hard clay subsoil and considerable gravel in places. The soil might be suitable for crop raising but the entire township, with the exception of a few sections in the northeasterly corner, is altogether too hilly. No timber or scrub of any kind grows in this township. Hay is rather scarce as there are very few hay sloughs. There is a fair supply of fresh water supplied by those sloughs and a number of small lakes and reedy marshes. There are no streams, and, of course, no water-powers. The climate is very dry. No summer frosts were noticed but there were late spring and early fall frosts. The winters are reported to be severe but stock is able to winter out without protection. There is no fuel within the township unless there are underlying seams of coal, but coal is obtainable in township 3, range 21. No stone quarries or minerals were noticed. A few antelope were seen in this township.—*I. J. Steele, D.L.S., 1908.*

4. This township is most readily reached from Weyburn by taking what is known as the 'Gap' trail as far as township 6 and thence going across country. This trail is a good one, except in the spring. The soil is a clay loam with a clay subsoil. There is considerable gravel and stone in places. The soil might be suitable for crop raising but most of the township is much too hilly, particularly the western part. No timber or scrub grows in the township. There is a fair quantity of hay, as quite a few hay sloughs are scattered throughout the township. These sloughs with several fresh water lakes form a good supply of fresh water. The lake at the northeast corner of section 16 is slightly alkaline. There are no streams and consequently no water-powers. The climate is very dry. No summer frosts were noticed but there were late spring and early fall frosts. The winters are reported to be severe but stock can winter out without protection. There is no fuel whatever in this township, but lignite is available in township 3, range 21. No stone quarries or minerals were noticed. A few antelope and duck were seen.—*I. J. Steele, D.L.S., 1908.*

Range 21.

2. This township is most readily reached from Weyburn by taking what is known as the 'French' trail as far as a country store in township 5, range 19, thence a trail to the police barracks as far as township 2, range 20, and thence across country. This trail is a good one, except in the spring, as far as the country store. Beyond there it is little more than a track and hard to follow. The soil is a clay loam with a hard gravelly clay subsoil. There is a good growth of grass south of the lake which would seem to indicate a fairly good soil but owing to the dry climate and hilly nature of the country it is probably only suitable for grazing. This entire township may be

Range 21—Continued.

described as hilly prairie and there is no timber or scrub whatever found within its limits. There is very little hay found in the township as there are few hay sloughs. Big Muddy lake extends right across this township from the east boundary of section 13 to the west boundary of section 36. It is quite alkaline but stock will drink it. There are a few springs along its banks which furnish about the only fresh water to be had and the supply is very limited. There are no streams, and of course no water-powers. The climate is very dry. No summer frosts were noticed, but there were late spring and early fall frosts. The winters are reported to be severe but stock can winter out without protection. There is no fuel within the township unless there are underlying seams of coal, but coal is obtainable in township 1, range 22, and township 3, range 21. An outcrop of stone was seen in sections 22 and 23 on the lake shore. It appeared to be a rather shaly sandstone and rather soft. It would not be very suitable for building purposes. No minerals were noticed. A few antelope, duck, geese and pelicans were seen in this township. Numerous pieces of petrified wood were found along the shore of the lake.—*I. J. Steele, D.L.S., 1908.*

3. This township is most readily reached from Weyburn by taking what is known as the 'Gap' trail as far as township 6, thence turning south on one of the wood trails that reach down into this township. This trail is a good one except in the spring. The soil is a clay loam with hard clay subsoil. There is considerable gravel and stone in places. The soil might be suitable for crop raising but the entire township with the exception of a few sections is much too hilly. No timber grows in this township. A very little scrub ash and willow is found in some of the ravines but most of it has already been taken by the settlers to the north. Hay is rather scarce in this township as there are very few hay sloughs. A bay of Big Muddy lake extends into sections 5 and 6. The water is rather alkaline but stock will drink it. A number of springs in sections 6 and 7 give a good flow of fresh water. There is also a fresh water lake in section 24 and some marshes in a large coulée running through the township. There are no streams and of course no water-powers. The climate is very dry. No summer frosts were noticed but there were late spring and early fall frosts. The winters are reported to be severe but stock can winter out without protection. A lignite seam has been opened up in section 17 and furnishes fuel for all the settlers within reach. Numerous outcrops of limestone were noticed along the sides of the main coulée running from section 36 to section 5. It appeared to be a good quality of building stone. No minerals were noticed. A few antelope and duck were seen in this township.—*I. J. Steele, D.L.S., 1908.*

4. This township is most readily reached from Weyburn by what is known as the 'Gap' trail as far as township 6, range 20, and thence going across country. This trail is a good one except in the spring. The soil is a clay loam with a clay subsoil with considerable gravel in places. The soil might be suitable for crop raising but the entire township with the exception of a few quarter sections is much too hilly. No timber or scrub of any kind grows in the township. Hay is plentiful and of fair quality as there are numerous hay sloughs scattered throughout the township but more particularly in the central part. The sloughs together with a small lake in section 34 form the only supply of fresh water. The large lake in the easterly part of the township is much too salty to be of any use. There are no streams and consequently no water-powers. The climate was very dry. No summer frosts were seen but there were numerous late spring and early fall frosts. The winters are reported to be severe but stock can winter out without protection. There is no fuel whatever in this township unless there are underlying seams of lignite. Lignite is available in township 3. No stone quarries or minerals were noticed. A few antelope and duck were seen.—*I. J. Steele, D.L.S., 1908.*

Range 21—Continued.

46. This township is somewhat similar to township 46, range 22. The surface is slightly rolling. Poplar bluffs and poplar and willow scrub cover a larger portion of the ground. The timber is not large enough or suitable for lumber. On every section there is timber large enough for rough log buildings. The soil is a sandy loam of good quality, with a clay subsoil. It raises good grain crops and excellent roots and other vegetables. The most of the grain was cut in time to escape much damage by frost this year, but last season as in many other districts, it was badly damaged. The whole township is broken by sloughs and lakes. A large body of water lies in section 30 with a good deal of swamp around it, but another with good shores lies in section 21. A very much broken and irregular one is found in sections 36 and 26. A large lake containing small scattered islands breaks the east boundary of section 36, and another surrounded by small hills takes up a good portion of the northeast quarter of section 24. The strip on the east side of the township consisting of sections 1, 12 and 13, is very much broken by sloughs. None of these bodies of water appear to have outlets. The water in nearly all the sloughs and lakes is alkaline, to some extent, but not enough to make it unfit for stock. Carrot river crosses the township, flowing northerly through a narrow valley in a very crooked channel from twenty to thirty-five feet wide and three to four feet deep. It skirts the east boundaries of sections 22, 27 and 34. Nearly all the sloughs are surrounded by strips of good hay land. No large amount can be procured in one place. The district is well adapted for mixed farming. It is an excellent cattle and dairying country. No water-power of practical use is available other than a small power that could be developed on Carrot river by flooding a considerable area of land. It would not be permanent and of no use in winter. No minerals of economic value were seen. Ducks were plentiful, other wild fowl were scarce, but coyotes, skunks and badgers were often seen. Most of the even sections are taken up, mainly by Scandinavians from Europe and the northwestern United States. They are making good progress and bid fair to make good farmers. A graded road made by the Saskatchewan government runs through the township on the road allowance on the east boundaries of sections 19, 30 and 31. It extends north across Peonan creek in the north township and south to the town of Kinistino.—*W. R. Reilly, D. L. S., 1908.*

51. This township lies about twenty miles by trail northwesterly from Fort a la Corne. This wagon trail runs north, from Saskatchewan river, to the north of township 50 ,range 20, thence northwesterly to this township entering it in section 13. The condition of this trail is good but rather inclined to be hilly near Saskatchewan river. North of Whitefox river the soil is black loam, averaging twelve inches, with clay subsoil, and should be suitable for mixed farming. South of Whitefox river the soil is sand. The surface is wooded, or scrubby, covered with poplar north of the river, and jackpine, spruce, and tamarack south of it. There are large patches of scrubby poplar and willow. The timber in this township consists of jackpine, poplar, balm of Gilead, spruce and tamarack. There are several large hay sloughs north of Whitefox river, from which a large quantity of good slough hay could be obtained. Whitefox river has a width averaging forty feet with a variable depth from two to ten feet, and has a current of two and one-half miles per hour. The water is excellent. The river enters in section 6, and running in an east northeasterly direction leaves the township in section 13. Large muskegs lie south of the river. There is no waterfall available. The climate this summer was cool and damp, the first frost being noticed on August 20. Deadwood in abundance is available for fuel. No stone, coal, or minerals are to be found. Moose and jumping deer are plentiful.—*R. H. Montgomery, D.L.S., 1907.*

TOWNSHIPS WEST OF THE SECOND MERIDIAN.

Range 22.

1. This township is most readily reached from Weyburn by taking what is known as the 'French' trail to a small country store in township 5, range 19, thence a trail which passes around the east end of Big Muddy lake to the police barracks. This trail is a good one as far as the store, but beyond there it is little travelled and hard to follow and in the spring is practically impassable. The soil is a clay loam with a hard clay subsoil and might be suitable for agricultural purposes if the ground were not so rough. In the Big Muddy valley there is too much alkali to permit of cropping. A rancher had a small field of oats in section 3 but they did not seem to be growing well. This entire township is very much broken up by deep ravines running into the Big Muddy valley which render it unfit for anything but ranching. There is no timber but a few clumps of small poplar and scrub grow in the ravines. There are no hay sloughs in this township, but hay of excellent quality grows in most parts of the Big Muddy valley, so that the possible yearly cut would be a good many hundred tons. Springs furnish about the only water in the township. The best one is at the police barracks, but another good one was seen in section 24. There are numerous other smaller ones in the township some of which are salty. There are of course no water-powers. The climate appeared to be very dry. There are late spring and early fall frosts but none were noticed in midsummer. The winters are said to be severe but less snow falls than a little farther west. In the fall there were several inches of snow on the uplands when there was none in the valley. For fuel there is an abundance of coal in the township and also a little scrub. Indications of coal were seen in a great many places and a pit has been opened in section 16. It is a lignite of fair quality but disintegrates rather rapidly when exposed to the weather. A few pieces of crystalline gypsum were picked up but no other mineral or stone quarries were seen. No game was seen in the township.—*I. J. Steele, D.L.S., 1908.*

2. This township may be reached from Weyburn by taking what is known as the 'French' trail as far as a country store in township 5, range 19, thence a trail to the police barracks as far as the east boundary of township 1, range 22, and thence going across country. This trail is a good one as far as the store except in the spring. Beyond that the trail is little more than a track and difficult to follow. The part of the township north of Big Muddy lake is probably best reached by taking the 'Gap' trail from Weyburn to within a few miles of Livingstone's ranch, thence going across country. The soil is a clay loam with a hard clay subsoil. A few quarter sections north of the lake might be suitable for crop raising but are rather hilly. On the south side of the lake this township is extremely hilly and entirely unfit for anything but grazing. There is no timber of any size but considerable poplar and willow scrub grows on the north hillsides south of the lake. None is found north of the lake. Hay is not very plentiful, but some grows in the Big Muddy valley in sections 2 and 3. There is a good growth of grass in many of the ravines but it could hardly be utilized for hay. The water in Big Muddy lake is alkaline but range stock will drink it. The only fresh water obtainable comes from a few springs in the ravines along the shores of Big Muddy lake. There is quite a flow from a spring in section 18, but the rest are all very small. A few sloughs north of the lake supplement the supply a little. There are no streams and consequently no water-powers. The climate is very dry. No summer frosts were noticed but there are late spring and early fall frosts. The winters are reported to be severe but stock can winter out without protection. There is a small quantity of scrub in the ravines south of the lake which may be used for fuel, but the supply is very limited. Indications of lignite were seen but no seams have been opened. Lignite is obtainable in township 1. No stone quarries or minerals were noticed. No game was seen in this township. All this township north of Big Muddy lake is included in Livingstone's range.—*I. J. Steele, D.L.S., 1908.*

Range 22—Continued.

44. This is a poplar bluff country with large prairie openings and many sloughs, lakes and patches of swamp. The bluffs are formed by young growing poplar in many places ten inches in diameter, clumps of willows, poplar and willow underbrush. They supply abundance of fuel, fencing and rough building material. The heaviest clumps and belts are found on the west sides of sections 19 and 30 and the south parts of sections 4, 5 and 6. The surface is flat in the northeast corner of the township, undulating to rolling in the interior, gradually rising to a hilly country in the townships to the south and west. A small creek enters the township in the southwest corner of section 6, meanders through sections 6, 7 and 17 and is joined in section 16 by a branch from the south, through sections 4 and 9. From section 16 it continues through sections 21, 22, 27, 26 and 35 passing through swamps and lakes into a large swamp on the east boundary of the township. This swamp extends northeasterly for several miles, draining into Carrot river in township 45, range 21. The water in this creek above the swamp is excellent. Six lakes were traversed. The lake in sections 22 and 27 and the one in sections 28 and 29 are materially different to what is shown on the original plan. It is a good township for stock raising and dairying. It has special advantages for the settlers in being well watered, good soil, abundance of hay and fuel and a liberal supply of fencing and rough building material. A number of settlers have taken up homesteads. They are making good progress and apparently doing well. Ducks are plentiful. Prairie-chickens and other wild fowl are scarce. Coyotes, muskrats and badgers were often seen. No trace of other fur bearing animals was noticed. No minerals of economic value were noticed and no water-power nor stone of any kind was found. The Saskatchewan government has done this season a considerable amount of grading on a road on the east boundaries of sections 15 and 22, extending into section 26.—*W. R. Reilly, D.L.S., 1908.*

46. This township, which is fractional, is rolling in the southwestern portion, while undulating in the north and northeastern portions. A considerable portion of the township is covered with poplar and willow bluffs. The poplar in all cases grows large enough for fence rails, and the willow for fence pickets. In the east and northwest of the township there is a quantity of poplar large enough for rough building purposes. Peonan creek runs across the northwest corner of the township. It enters about twenty chains south of the northwest corner of the township and meanders across the north half of sections 31, 32 and 33, leaving the township a few chains east of the northeast corner of section 33. This creek contains excellent water and does not dry up in the summer. It is from ten to twenty-five feet wide and two to four feet deep. A succession of lakes and sloughs, which I traversed, cuts the southwestern portion of the township. A large one with swampy shores cuts sections 35, 36, 25 and 26. Another lake on the east boundary cuts section 25. The water in these lakes and sloughs is slightly alkaline, but not strong enough to injure stock. The soil is a loam of good quality and produces good crops of wheat, oats, barley and excellent roots and other vegetables. Most of the homesteads have been taken up. The settlers are mostly Scandinavians from the northwestern United States, who appear to be very prosperous. They have made permanent improvements and in a short time will have excellent farms. A considerable amount of road improvements have been made. The road on the east side of sections 29 and 32 and on the north side of 21 and 22 has been graded. The Canadian Northern railway cuts the township from section 31 to section 22. There is no water-power available in this township and no minerals of economic value were met with. Ducks were numerous. Prairie-chickens are plentiful, but geese and sand-hill cranes are scarce. Coyotes, skunks, gophers, and other fur bearing animals were seldom met with.—*W. R. Reilly, D.L.S., 1908.*

Range 22—Continued.

49. This township, like township 49, range 23, is cut in two by Saskatchewan river which enters at the southwest corner of section 31. It flows in a very zigzag course across the township, being joined in the southwest corner of section 24, by the south branch. The banks are much the same as in range 23, from twenty to one hundred feet high, alternating from one bank to the other. Generally where one side is high the other will be low. The stream is much swifter than in range 23, being virtually a succession of rapids from the west boundary to where it is joined by the south branch. A ferry was being put in by the Saskatchewan government a few chains east of the west boundary. The part of the township lying north of the river slopes back to a height of about two hundred feet, from the river. Section 31 is rolling in the north with long slopes to the south towards the river. It has some scattered openings and is the only part north of the river that can be said to be fit for cultivation. From sections 31 to 36, along the north boundary are spruce and tamarack swamps or muskegs with intervening jackpine ridges. The river valley is formed by ranges of hills that stretch from bend to bend. Between the bends are large flats which are covered with poplar and willow. In the flats in sections 26 and 27 are two crescent-shaped swamps; these are apparently old beds of the river. A heavy belt of poplar from six to twelve inches in diameter covers the ground between these swamps and a large amount of young poplar covers the flats in sections 22, 23 and 24. Small swamps and jackpine ridges with patches of poplar cover the remainder of the township. A large amount of poplar is large enough for building and other purposes. A good deal of jackpine is scrubby. It is not very heavy or extensive in any place, but by going over the whole area, a large amount of railway ties could be made. The soil in section 31 and in the flats along the river is a good rich loam with a sandy subsoil, while most of the remainder of this part of the township is light sand. No minerals or stone quarries were found. Game was scarce, some traces of mink, foxes, coyotes, &c., were noticed. A few jumping deer were seen.—*W. R. Reilly, D.L.S., 1908.*

Range 23.

1. (South outline.) This township may be reached from Weyburn by taking what is known as the 'French' trail to the Diamond crossing at the east end of Big Muddy lake, thence taking the police trail to the Big Muddy barracks and thence the Willowbunch police trail westerly; it may also be reached from Moosejaw by taking the Willowbunch trail to Willowbunch thence the Scobie trail southerly. This township is not quite as hilly as the townships to the north and in places is fairly level. The soil in places might be suitable for agriculture, but owing to the dryness of the climate, might be better adapted for ranching. There are very few sloughs in this township. No timber or scrub whatever is found, but there are indications of coal suitable for fuel. The climate is very dry, particularly in the summer, and the winters are reported to be very severe.—*I. J. Steele, D.L.S., 1908.*

2. This township is most readily reached from Weyburn by taking what is known as the "Gap" trail to Livingstone's ranch, thence a trail to the police barracks which passes through this township. This trail is a good one except in the spring. The soil is a clay loam with a hard clay subsoil and considerable gravel in places. The easterly part of the township is very much broken by deep ravines while the rest is very hilly and broken by dry valleys. With the exception of a very few quarter sections, this township is fit only for ranching. There is no timber but a little scrub was seen in some of the ravines in the easterly part of the township. Very little hay was seen in this township, a few sloughs in the northerly part being the only source of supply.

Range 23—Continued.

Big Muddy lake extends into section 24, 25 and 36. The water is alkaline but ranch stock will drink it. The few sloughs previously mentioned form the only other source of supply. There are no water-powers as there are no streams. The climate is very dry. No summer frosts were noticed, but there were late spring and early fall frosts. The winters are reported to be rather severe but ranch stock need no protection. There is practically no fuel within the township unless there are underlying seams of coal, as the little scrub growing in the ravines is scarcely worth mentioning. Scrub is available in the township to the east, and coal in township 1, range 22. No stone quarries or minerals were seen. With the exception of a few duck no game was noticed in this township.—*I. J. Steele, D.L.S., 1908.*

49. This township is cut in two by Saskatchewan river. It enters the township on the west at the northwest corner of section 18 and flows with several large bends in a northeasterly direction to the southeast corner of section 36. Its banks are broken and vary from twenty to one hundred feet high alternating from one bank to the other. Generally where it is high on one side it is low on the opposite. The current is swift in high water with no rapids of any account. In low water several strong rapids are formed. The country north of the river gradually rises to the north to a height of about two hundred feet above the river. The surface is rolling with slopes, flats and steeps, with a heavy growth of poplar in most places; the heaviest on the west side of the township. A few scrubby openings occur on sections 36 and 35. Many large patches of swampy ground are found, dotted with clumps of willow. Garden river meanders from the northwest corner of section 32, through sections 32 and 29, and empties into the Saskatchewan on the east side of section 20. It is from thirty to forty feet wide and from one to four feet deep with a rapid current. The country south of the Saskatchewan, with the exception of a short distance from the river, which is broken, is but slightly rolling and generally flat along the south part of the township. The greater part of the south half of section 18, sections 7 and 6, and a part of sections 8 and 5 has been covered with a heavy growth of thrifty jackpine, a great quantity of it being large enough for railway ties, but the most of it has been pretty well run over, and a great amount of building and other material taken off it. Heavy bluffs of poplar are found on most sections, this being a poplar bluff country with large scrubby openings. A number of sloughs are scattered over the township. They are more numerous in the southeast quarter of the township. Two large lakes, one cutting sections 15, 10 and 11 and the other sections 11 and 12 were traversed. A small spring creek with excellent water runs through section 18. Another one known as Steep creek runs through sections 15 and 22. Away from the jackpine ridges the soil is good, mostly a dark sandy loam with a sandy subsoil. Hay and water are plentiful, also fuel and rough building material. The most of the homesteads on the south side of the river are taken up and a couple of farms on odd sections are being worked. Generally speaking the country has a backward appearance. Hay of good quality in limited quantities can be gathered from around most of the sloughs throughout the township. Upland hay can be cut in several places. It is limited in quantity and not of the best quality as the ground is brushy and weedy. This is a good mixed farming district and an excellent cattle and hog raising district. Steep Creek postoffice is on the southwest quarter of section 24.—*W. R. Reilly, D.L.S., 1908.*

Range 24.

1. (South outline). This township may be reached from Weyburn by taking what is known as the 'French' trail to the Diamond crossing at the east end of Big Muddy lake, thence taking the police trail to the Big Muddy barracks and thence the

Range 24—Continued.

Willowbunch police trail westerly; it may also be reached from Moosejaw by taking the Willowbunch trail to Willowbunch, thence the Scobie trail southerly. This township is not quite as hilly as the townships to the north and in places is fairly level. The soil in places might be suitable for agriculture, but owing to the dryness of the climate, might be better adapted for ranching. There are very few sloughs in this township. No timber or scrub whatever is found but there are indications of coal suitable for fuel. The climate is very dry, particularly in the summer, and the winters are reported to be very severe.—*I. J. Steele, D.L.S., 1908.*

1. (East outline). This township may be reached from Weyburn by taking what is known as the 'French' trail to the Diamond crossing at the east end of Big Muddy lake, thence taking the police trail to the Big Muddy barracks and thence the Willowbunch police trail westerly; it may also be reached from Moosejaw by taking the Willowbunch trail to Willowbunch, thence the Scobie trail southerly. This township is not quite as hilly as the townships to the north and in places is fairly level. The soil in places might be suitable for agriculture, but owing to the dryness of the climate, might be better adapted for ranching. There are very few sloughs in this township. No timber or scrub whatever is found but there are indications of coal suitable for fuel. The climate is very dry, particularly in the summer, and the winters are reported to be very severe.—*I. J. Steele, D.L.S., 1908.*

2. This township is best reached from Weyburn by taking what is known as the 'Gap' trail to Livingstone's ranch thence taking the trail in the Big Muddy valley to George's ranch in section 27, township 3, thence across country. This trail is good except in the spring. The soil is a clay loam with a hard dry clay subsoil and would be suitable for agriculture if the surface were sufficiently level. There is no timber or scrub in this township. It is very much cut up with dry coulées which make it unfit for farming except in a few sections. There is no hay whatever. Two branches of Beaver creek pass through the township but both were almost dry at the time of the survey (September) and no doubt are dry for most of the season. These streams are the only source of supply of water as there are practically no sloughs in the township and no springs were seen. The climate was very dry, particularly in the summer. There are late spring and early fall frosts which would make farming a doubtful proposition and the winters are reported to be rather severe. No stone quarries or minerals were seen. A small quantity of dead poplar scrub in the township to the north is available for fuel but there is not sufficient to last any length of time. Lignite coal of an inferior quality is found in the township to the north and also in township 1, range 22, and no doubt could be found nearer at hand. No game was seen but there are supposed to be a few antelope in the locality.—*I. J. Steele, D.L.S., 1908.*

3. This township is most readily reached from Weyburn by taking what is known as the 'Gap' trail as far as Livingstone's ranch, thence following the trail in the Big Muddy valley, which passes through this township. This trail is good except in the spring. On the upland the soil is a clay loam with a hard clay subsoil. In the valley the soil is what is known as gumbo. During the wet spring weather it is very soft but dries out hard in the summer. No large timber grows in this township but there is considerable scrub in some of the ravines which cut up most of the township and make it entirely unfit for anything but ranching. A very small quantity of hay grows around a few sloughs in the southerly part of the township but not enough to be of much value. These sloughs, together with a few springs in the ravines, furnish the only supply of water. Most of the sloughs dry up in summer but the springs are fairly permanent. There are no water-powers. The scrub in the ravines is available for fuel

Range 24—Continued.

but is limited in quantity. There are plenty indications of lignite in this township but no seams were found. No stone quarries or minerals were seen. A few prairie-chicken were the only game seen but there are supposed to be a few antelope in the locality. The climate is very dry, particularly in the summer. There are late spring and early fall frosts on the uplands but in the Big Muddy valley it seems to be warmer. At the time of survey (September) there were several inches of snowfall on the upland but none in the valley.—*I. J. Steele, D.L.S.*, 1908.

47. This is a fractional wooded township. An Indian reserve covers the greater part of the north half of it. The surface is rolling in the southwest quarter, and slightly rolling in the southeast quarter of the township. It is comparatively level in sections 24, 25 and 36, and along the Indian boundary. Many fresh water sloughs of small extent dot the south part of the township. In the north they are more numerous and larger, covering a considerable part of the surface. A large marsh extends across section 3 into the north part of section 4. A drain has been dug in this marsh through section 4 into section 5, following a small creek running through section 6. Large prairie openings occur in the south part of the township and a few small scrubby openings in the north. Poplar, with willow, alder and hazel bush cover the greater part of the surface. Clumps and belts of poplar with timber large enough for rough building, fencing and fuel are found on every section. Hay of good quality is fairly plentiful in the tier of sections along the south boundary. A large quantity can be cut from many sloughs in all parts of the township. The soil is a good quality of loam, and will produce good grain, roots and other vegetables. The ground is much broken with sloughs which impair its value for farming purposes. On the other hand the close proximity of a railway station enhances its value to a great extent. The south branch of Saskatchewan river cuts the west boundaries of sections 7 and 18. A small lake was traversed in sections 10 and 11. No water-power nor minerals of economic value were found, and no stone except boulders along the river. Ducks were plentiful, but small fur bearing animals scarce, and there were no signs of large game. A number of homesteads have been taken up recently and a small amount of improvements made. A few old settlers in the south part of the township have large improvements. —*W. R. Reilly, D.L.S.*, 1908.

Range 25.

1. (South outline). This township may be reached from Weyburn by taking what is known as the 'French' trail to the Diamond crossing at the east end of Big Muddy lake, thence taking the police trail to the Big Muddy barracks, and thence the Willowbunch police trail westerly; it may also be reached from Moosejaw by taking the Willowbunch trail to Willowbunch, thence the Scobie trail southerly. This township is not quite as hilly as the townships to the north and in places is fairly level. The soil in places might be suitable for agriculture, but owing to the dryness of the climate might be better adapted for ranching. There are very few sloughs in this township. No timber or scrub whatever is found but there are indications of coal suitable for fuel. The climate is very dry, particularly in the summer, and the winters are reported to be very severe.—*I. J. Steele, D.L.S.*, 1908.

2. This township may best be reached from Weyburn by taking what is known as the 'Gap' trail to Livingstone's ranch, thence following the trail in the Big Muddy valley to Ange's ranch, thence across country. The trail is a good one except in the spring. The soil is a clay loam with a hard white clay subsoil with considerable gravel in places, particularly in the northern part of the township. There is absolutely no

Range 25—Continued.

timber or scrub in this township. Most of the township is badly cut up with coulées and the northern part is very hilly. In the southern part there are a few sections which are fairly level and might be suitable for farming, but most of the township is fit only for ranching. There are no hay sloughs but there is a fairly good growth of grass in some of the coulées which might be used for this purpose. A very small creek crosses the south boundary of section 5 but it is dry a little farther north and is no doubt entirely dry during most of the season. In the northern part of the township there are a few small springs which furnish a limited amount of good water. There are no water-powers and no stone quarries or minerals were seen. No game was seen but there are supposed to be a few antelope in the vicinity. The climate is usually very dry, particularly in summer. There are late spring and early fall frosts, and the winters are said to be very severe.—*I. J. Steele, D.L.S., 1908.*

3. This township is most readily reached from Weyburn by taking what is known as the 'Gap' trail to Livingstone's ranch, thence following the trail in the Big Muddy valley which passes through this township. This trail is good except in the spring. On the upland the soil is a clay loam with a hard dry clay subsoil and considerable gravel along the south boundary. In the valley the soil is known as gumbo. During the wet spring weather it is very soft but dries out hard in the summer. No large timber grows in this township but there is considerable scrub in the ravines and on the north slope of the hills. The surface is extremely broken and a high range of hills extends across the south part of the township forming a watershed. There are very few quarter sections that are level enough for farming purposes. No hay grows in this township except a little in section 14. The only available water is from a few small springs in the ravines and along the edge of the Big Muddy valley and in a small lake extending into section 7 from range 26. The supply is fairly permanent but limited. There are no water-powers. A considerable quantity of scrub in the ravines and on the north slope of the hills is available for fuel but is rapidly disappearing as the settlers to the north secure fuel here. No coal or lignite veins were found although there were traces of lignite in places, and no stone quarries or minerals were seen. No game was seen but there are supposed to be a few antelope in the vicinity. A rancher in section 31 manages to raise some oats and potatoes but the land has to be irrigated. —*I. J. Steele, D.L.S., 1908.*

47. This is a fractional township, which consists of a part of section 1 and the southeast corner of section 12. It is bounded on the northwest side by the south branch of Saskatchewan river. The river bank rises to a height of about one hundred feet above the water. It is heavily wooded with poplar of small size and a thick growth of willow, poplar and alder underbrush. A small creek in a deep ravine with high sloping wooded banks runs through the south half of section 1. South of the creek the land is rolling with scattered bluffs of poplar and clumps of willow and poplar brush. North of the creek the ground is rolling and heavily wooded with young growing poplar averaging five to ten inches in diameter. A large part of it is pretty free from underbrush, but in other places tangled willow and alder grow. The soil is a rich black loam on a clay subsoil. A small quantity of hay can be cut from odd fresh water sloughs in the south part of the township. The land is vacant and no improvements have been made. No minerals and no water-powers were found and no stone except boulders along the river. Game was very scarce.—*Wm. R. Reilly, D.L.S., 1908.*

49. In the immediate vicinity of Saskatchewan river the soil is first class and timbered with poplar and willow. More remote from the river the soil is a scrubby muskeg or rolling sand hills covered with jackpine. There is a fairly good summer

Range 25—Continued.

trail leading from Prince Albert ferry through this township. All the water is fresh and of excellent quality. I saw no hay meadows or water-powers. There were no frosts during the survey, but there were two hail storms. There is an abundance of wood for fuel and other purposes. No quarries or minerals of any kind were seen. There is, however, an abundance of building sand and brick clay, and brick is manufactured in section 22. Deer was the only game seen.—*Geo. McMillan, D.L.S., 1908.*

Range 26.

1. (South outline.) This township may be reached from Weyburn by taking what is known as the 'French' trail to the Diamond crossing at the east end of Big Muddy lake, thence taking the police trail to the Big Muddy barracks and thence the Willowbunch police trail westerly; it may also be reached from Moosejaw by taking the Willowbunch trail to Willowbunch, thence the Scobie trail southerly. This township is not quite as hilly as the townships to the north and in places is fairly level. The soil in places might be suitable for agriculture, but owing to the dryness of the climate might be better adapted for ranching. There are very few sloughs in this township. No timber or scrub whatever is found, but there are indications of coal suitable for fuel. The climate is very dry, particularly in the summer, and the winters are reported to be very severe.—*I. J. Steele, D.L.S., 1908.*

1. (East outline.) This township may be reached from Weyburn by taking what is known as the 'French' trail to the Diamond crossing at the east end of Big Muddy lake, thence taking the police trail to the Big Muddy barracks and thence the Willowbunch police trail westerly; it may also be reached from Moosejaw by taking the Willowbunch trail to Willowbunch, thence the Scobie trail southerly. This township is not quite as hilly as the townships to the north and in places is fairly level. The soil in places might be suitable for agriculture, but owing to the dryness of the climate might be better adapted for ranching. There are very few sloughs in this township. No timber or scrub whatever is found, but there are indications of coal suitable for fuel. The climate is very dry, particularly in the summer and the winters are reported to be very severe.—*I. J. Steele, D.L.S., 1908.*

2. This township may be reached from Moosejaw by taking the Willowbunch trail to Willowbunch then the Scobie trail running southerly which enters this township on section 19. It may also be reached from Weyburn by taking what is known as the "Gap" trail to Livingstone's ranch, thence following the trail in the Big Muddy valley to Holly's ranch at the northeast corner of township 3, thence taking one of Holly's hay trails to within a mile or two of the north boundary of the township. The soil is a clay loam from two to ten inches deep but in the southerly part of the township there is considerable gravel. The subsoil is a hard, white, gravelly clay. The soil in some places might be suitable for agriculture but the whole township with the exception of two or three sections is too hilly and broken and the climate is so unsatisfactory that this township is probably more suitable for ranching purposes. No timber or scrub grows in this township and the surface as stated above may be described as hilly prairie, the hills having no regularity or definite formation. There is some hay slough, about twenty acres in extent, in section 25 and a certain amount of hay is obtainable along the creek which runs through the western part of the township. This fresh water creek is about three feet wide and a few inches deep and with the exception of a few sloughs in the northeasterly part is the only water in the township. There are no water-powers on it. The climate is very dry, particularly in the summer,

Range 26—Continued.

and the winters are reported to be long and severe. There are also summer frosts. No stone quarries or minerals were discovered. A few duck was the only game seen but there are supposed to be a few antelope in the locality.—*I. J. Steele, D.L.S., 1908.*

3. This township is most easily reached from Weyburn by taking what is known as the 'Gap' trail to Livingstone's ranch, thence following the trail in the Big Muddy valley to Holly's ranch, which is at the northeast corner of the township. This trail is good except in spring. The soil is a clay loam with a hard, dry, clay subsoil and might be suitable for crop raising if other things were favourable. There is no timber in this township but a little scrub grows in the northerly part. The surface is rather broken, particularly in the northeast corner and along the north boundary. There are a few small hay sloughs in the east half of the township, but the hay is rather coarse and inferior and in no great quantity. A small lake of good fresh water covers parts of sections 1 and 12 which will probably not go dry. There is also a small fresh water creek running through sections 6 and 7 which does not go dry. At the time of the survey (October) it was about three feet wide and eight inches deep. There are no water-powers on it. The few hay sloughs dry up early and are of little importance. The climate is generally very dry, particularly in the summer. There are late spring and early fall frosts, and the winters are said to be severe. A small quantity of scrub is available for fuel in the northerly part of the township and there is considerable in township 3, range 25. No coal or lignite veins were found, nor were any stone quarries or minerals seen. No game was seen but there are supposed to be a few antelope in the locality.—*I. J. Steele, D.L.S., 1908.*

Range 27.

1. (East outline.) This township may be reached from Weyburn by taking what is known as the 'French' trail to the Diamond crossing at the east end of Big Muddy lake, thence taking the police trail to the Big Muddy barracks and thence the Willowbunch police trail westerly; it may also be reached from Moosejaw by taking the Willowbunch trail to Willowbunch thence the Scobie trail southerly. This township is not quite as hilly as the townships to the north and in places is fairly level. The soil in places might be suitable for agriculture, but owing to the dryness of the climate, might be better adapted for ranching. There are very few sloughs in this township. No timber or scrub whatever is found but there are indications of coal suitable for fuel. The climate is very dry, particularly in the summer, and the winters are reported to be very severe.—*I. J. Steele, D.L.S., 1908.*

1. (South outline.) This township may be reached from Weyburn by taking what is known as the 'French' trail to the Diamond crossing at the east end of Big Muddy lake, thence taking the police trail to the Big Muddy barracks and thence the Willowbunch police trail westerly; it may also be reached from Moosejaw by taking the Willowbunch trail to Willowbunch, thence the Scobie trail southerly. This township is not quite as hilly as the townships to the north and in places is fairly level. The soil in places might be suitable for agriculture, but owing to the dryness of the climate might be better adapted for ranching. There are very few sloughs in the township. No timber or scrub whatever is found but there are indications of coal suitable for fuel. The climate is very dry, particularly in the summer, and the winters are reported to be very severe.—*I. J. Steele, D.L.S., 1908.*

2. This township may be reached from Moosejaw by taking the Willowbranch trail to Willowbunch, thence a trail going southerly which enters this township on the north boundary section 35. It may also be reached from Weyburn by taking what is known

TOWNSHIPS WEST OF THE SECOND MERIDIAN.

Range 27—Continued.

as the 'Gap' trail to Livingstone's ranch, thence following the trail in the Big Muddy valley to Holly's ranch at the northeast corner of township 3, range 26, thence across prairie to this township. The soil is a clay loam from two to ten inches in depth but in many places there is considerable gravel. The subsoil is a hard, white, gravelly clay. In the northerly part of the township there is a good growth of grass, appearing to indicate a fairly rich soil which might be suitable for agricultural purposes if other conditions were favourable. In the southerly part of the township there seems to be more gravel and some alkali in the vicinity of the creek running across the township. No timber or scrub whatever is found in this township and the surface as a whole may be described as rolling with the exception of some hills in sections 30 and 31 and in sections 26, 27, 34 and 36. There are no hay sloughs in this township but there is a fairly rank growth of grass in some places along the creeks which might be utilized for hay. A fresh water creek three feet wide and a few inches deep runs through section 36 which does not appear to go dry and there is also a creek entering the township on the west boundary of section 18 and leaving it at the south boundary of section 2, but it dries up in the dry season. However, a number of springs along its banks make a permanent supply of excellent water for all ordinary purposes. Neither stream is large enough for water-powers. There are no sloughs and no lands subject to floods. The main feature of the climate in this locality is the lack of rain during the summer which would be the principal drawback to grain raising, although there would also be considerable danger from summer frosts. It is understood that the winters are rather long and severe. There is no fuel whatever in this township unless there are underlying coal seams, which is quite possible as there are indications of coal not far away. A certain amount of scrub along the Big Muddy valley is available for fuel. No game was seen in this township with the exception of a few duck but it is understood that there are a few antelope in this locality. All things considered, this township would not make very good farming land but ought to be excellent for ranching purposes.—*I. J. Steele, D.L.S., 1908.*

Range 28.

1. (East outline.) This township may be reached from Weyburn by taking what is known as the 'French' trail to the Diamond crossing at the east end of Big Muddy lake, thence taking the police trail to Big Muddy barracks and thence the Willowbunch police trail westerly; it may also be reached from Moosejaw by taking the Willowbunch trail to Willowbunch thence the Scobie trail southerly. This township is not quite as hilly as the townships to the north and in places is fairly level. The soil in places might be suitable for agriculture, but owing to the dryness of the climate, might be better adapted for ranching. There are very few sloughs in this township. No timber or scrub whatever is found but there are indications of coal suitable for fuel. The climate is very dry particularly in the summer and the winters are reported to be very severe.—*I. J. Steele, D.L.S., 1908.*

TOWNSHIPS WEST OF THE THIRD MERIDIAN.

Range 1.

23. From the northeast corner of this township it was about ten miles to the village of Craik, a station on the Canadian Northern railway, the trail being in a fairly good condition and most of the way the roads have been graded. Here there are several elevators, a bank, two hotels and numerous mercantile establishments. From the southwest corner of the township it is about nine miles to Tugaske, a station on the Moosejaw to Outlook branch of the Canadian Pacific railway. There are elevators,

Range 1—Continued.

stores, a bank and boarding houses here, and a good trail leading right to this settlement or to Eyebrow, the next station on the line, about the same distance from this township. The soil is a black loam with generally a sandy subsoil and is suitable for raising the different kinds of cereals as well as vegetables. It consists mostly of undulating open prairie without any timber or brush whatever. There are a number of small grassy ponds but most of the hay made here is obtained from the uplands. The water in the ponds is mostly good as is also the case in the wells dug by the settlers. There are no running streams except Squaw creek in which the water becomes very low in summer time. The climate is normal and not much subject to summer frosts. There is no fuel but what is obtained from the sand hills to the west or from the near by railway towns. No stone quarries nor any minerals were observed. No game was seen with the exception of a few ducks in ponds and marshes. This township is well settled and no more land is available for homesteading purposes, although that held by private companies and individuals is obtainable at fair prices.—*C. F. Miles, D.L.S., 1908.*

42. This township is traversed by Saskatchewan river and can be reached by an excellent trail by either of two routes, from Duck Lake settlement or Rosthern. There is a ferry crossing the river at the northeast corner of section 18 which is known as 'Gabriel's' crossing. East of the river the surface is rolling and covered with poplar, willow and scrub with many open spaces. The soil is fairly good although not cultivated to any great extent, it is largely used for grazing. West of the river it is a hilly, sandy, uncultivated prairie. The water supply is everywhere abundant and of good quality. The climate is excellent and there were no summer frosts. I saw no game, no quarries or other minerals. There are no water-powers although the Saskatchewan has a steady current. Its banks are high and the adjacent lands are not subject to floods.—*Geo. McMillan, D.L.S., 1908.*

43. This township is cut into by the St. Laurent settlement and One Arrow Indian reserve. It can be reached by trail from Duck Lake settlement as there is a ferry crossing the south branch of the Saskatchewan at Batoche. The soil is a sandy loam and is suited for stock raising or real farming. The surface is rolling and about thirty per cent prairie; the remainder is covered with poplar, willow and scrub. Poplar scales as high as twelve inches and is spread all over the township. Some hay is found in different parts of the township. There are many sloughs in which the water is good. No alkaline water was found. There are no available pater-powers although the river has a steady current throughout. The climate is good and all crops mature. I saw no summer frosts. Wood is the only fuel. I saw no quarries or minerals. A few ducks were the only game seen.—Geo. McMillan, *D.L.S., 1908.*

44. This township is traversed by the south branch of Saskatchewan river and can be reached by an excellent trail from Duck Lake settlement. There is a ferry crossing the Saskatchewan at St. Laurent, in Lot No. 5. The soil is fairly good although not much cultivated anywhere in the township. There is an abundance of poplar timber for fuel and other purposes. All the water is good. I saw no stone quarries or other minerals. No water-power or flooded lands were found. The surface is rolling and the drainage is natural. There were no summer frosts and the small crops matured well.—*Geo. McMillan D.L.S., 1908.*

Range 2.

6. The route for reaching this township is by a good trail running through Moosejaw to Wood mountain which lies from two to three miles west of this township. The soil consists of from six to twelve inches of dark sandy loam over a clay or sandy clay

Range 2—Continued.

subsoil and where not too rolling is well suited for mixed farming purposes. The surface is rolling or gently rolling prairie, but becomes very broken near the edge of Twelvemile lake, occasional small bluffs of poplar are to be found on the south side of the lake. Hay is rather scarce, but there are some small hay meadows especially in the north part of the township where small amounts of good hay can be cut. Water is plentiful and the supply permanent, being furnished by Twelvemile lake which averages about a mile wide, and extends through the centre of the township from east to west. This lake must be about twelve feet deep and the water is slightly brackish, but quite fit for use. No water-power can be developed. The climate is similar to that of the Moosejaw district and summer frosts are rare. Wood for fuel can be obtained about eight miles south and lignite coal about five miles south of this township. No stone or minerals were found. Ducks are plentiful around the lake but there are no fish in it.—*R. H. Cautley, D.L.S., 1908.*

Range 3

6. A good trail from Mossejaw to Wood mountain runs through the centre of this township entering it in section 34 and leaving it in section 4. The soil consists of from six to twelve inches of dark sandy loam over a clay or sandy clay subsoil and the east half of the township is suited for mixed farming purposes but the west half of the township is mostly too rolling for farming purposes and is more suitable for ranching. The surface in the east half of the township is gently rolling or rolling prairie, but in the west half it is more steeply rolling in character. Small bluffs of maple and poplar scrub occur in some of the ravines in the southwest corner of the township. Hay is rather scarce but there are some small hay meadows especially in the north part of the township, where small amounts of good hay can be cut. Water is plentiful and the supply permanent being furnished by Twelvemile lake which averages about a mile in width and extends about three and one-half miles into the township from the east boundary. This lake must be twelve feet deep in places and the water is slightly brackish but quite fit for use. There are also two flowing creeks one, which is ten feet wide, one foot deep and has a current of one mile an hour, the water of which is quite fresh, flows into the south side of the lake and the other, which is twelve feet wide, eighteen inches deep and has a current of one mile an hour, flows westward out of the lake. Both creeks cease flowing in July but a permanent supply of water is retained in deep pools along their courses. No water-power can be developed. The climate is similar to that of the Moosejaw district and summer frosts are rare. Wood for fuel can be obtained about eight miles south and lignite coal about five miles south of this township. No stone or minerals were found. Ducks are plentiful in the lake, but there are no fish in it.—*R. H. Cautley, D.L.S., 1908.*

7. The trail from Moosejaw to Wood mountain, which is a good trail, runs through the east end of this township, entering it in section 36, and leaving it in section 3. The soil consists of six to twelve inches of dark sandy loam over a clay or sandy clay subsoil and is well suited for mixed farming purposes. The surface is gently rolling and there is no bush of any description. Hay is very plentiful, there being numerous small hay meadows scattered all through the township, but it is of rather a poor quality. The supply of fresh water is plentiful and permanent, there being numerous large hay marshes with two to three feet of water in places, scattered through the township. No water-power can be developed. The climate is similar to that of the Moosejaw district and summer frosts are rare. Wood for fuel can be obtained about fourteen miles south and lignite coal about twelve miles south of this township. No stone or minerals were found. Antelope and jack-rabbits are the only kinds of game and they are very scarce.—*R. H. Cautley, D.L.S.,1908.*

Range 3—Continued.

8. The best route for reaching this township is by a good trail running from Moosejaw to Wood mountain through the township to the east, from where it is necessary to branch off across open prairie to this township. The old Wood mountain trail runs through the centre of this township, but is not used and is difficult to follow in places. The soil consists of from three to twelve inches of sandy loam over a clay or sandy clay subsoil, with stony patches in places, and is suitable for mixed farming purposes. The surface is undulating to gently rolling prairie and there is no bush of any description. Hay is fairly plentiful, there being numerous small hay meadows scattered all through the township, where hay of rather poor quality could be cut. Fresh water is fairly plentiful and the supply permanent, there being several wet hay marshes with two feet of water in places, scattered through the township, and in section 33, there is a fresh water lake with five to six feet of water in it. No water-power can be developed. The climate is similar to that of the Moosejaw district and summer frosts are rare. Wood for fuel can be obtained about twenty miles south and lignite coal about eighteen miles south of this township. No stone or minerals were found. Antelope and jack-rabbits are the only kind of game and they are very scarce —*R. H. Cautley, D.L.S., 1908.*

9. The best route for reaching this township is by the old Wood mountain trail, which branches off from the present trail at the southeast corner of Johnston lake. This trail passes through the centre of this township entering it in section 34, and leaving it in section 5, it is well travelled and a good trail as far as Thomson's store in the southwest quarter of section 34. The soil consists of from four to twelve inches of dark sandy loam over a clay or sandy clay subsoil and is well suited for mixed farming purposes, especially in the north half of the township where there is some very good land. The surface is undulating or gently rolling prairie and there is no bush of any description. There are numerous small hay meadows scattered through the township where small amounts of hay of good quality can be cut. The supply of fresh water is very limited but there are parts of two lakes which extend into this township, one in section 4 and the other, which is a very small lake, in section 18; both of these lakes contain fresh water, but the settlers depend chiefly on well water, which is of very poor quality and limited in supply. No water-power can be developed. The climate is similar to that of the Moosejaw district and summer frosts are rare. Wood for fuel can be obtained about twenty-six miles south and lignite coal about twenty-four miles south of this township. No stone or minerals were found. A few antelope and jack-rabbits were seen but are not very plentiful.—*R. H. Cautley, D.L.S., 1908.*

10. The best route for reaching this township is by the old Wood mountain trail which branches off from the present trail at the southeast corner of Johnston lake. This trail enters the township in section 24 and leaves it in section 3, and is a good level road. The soil varies a good deal in this township in places consisting of from four to twelve inches of sandy loam over a sandy clay subsoil and in others of a heavy clay or gumbo soil. It is all well suited for farming purposes. The surface is undulating prairie and there is no bush of any description. Hay is plentiful, there being several small hay meadows scattered all through the township, and in sections 10 and 11 there is a large hay meadow where at least two hundred tons of hay can be cut. The supply of fresh water is very limited there being no creeks or ponds in this township; nearly all the settlers were hauling water from a well in section 10 which was located in the centre of the hay meadow described above. No water-power can be developed. The climate is similar to that of the Moosejaw district and summer frosts are rare. Wood for fuel can be obtained about thirty-two miles south and lignite coal

TOWNSHIPS WEST OF THE THIRD MERIDIAN.

Range 3—Continued.

about thirty miles south of this township. No stone or minerals were found and no game of any kind was seen.—*R. H. Cautley, D.L.S., 1908.*

24. There is a good trail leading from this township along the north boundary of township 24, range 4 to Elbow, a station on the Moosejaw to Outlook branch of the Canadian Pacific railway about eight miles northwest of this township. There are three elevators, a bank, hotel, livery stables and stores of all kinds at the above mentioned settlement. The soil in this township is very light, in fact three-quarters of it is composed of sand hills and the remainder, the most northerly tier of sections are of a light sandy loam. This is all settled and under cultivation. Although the weather of the past season was not very propitious yet fairly good crops were realized. On one section where they had had two hundred acres of wheat, thirty-four hundred bushels were harvested, realizing nearly twenty-seven hundred dollars and a haul of only nine miles to the elevators at Elbow. The northern part is undulating open prairie but the balance is rolling sand hills covered for the most part with willow scrub and some small poplar, much of the latter being firekilled. There are some fair hay marshes and meadows in the sand hills, also good pasture in places. The water found in ponds and marshes is generally alkaline, but fairly good water has been obtained by settlers by digging wells. There are no water-powers. No summer frosts of any account prevail. Firekilled poplar and willow are available for fuel in the sand hills, but coal may be procured at the nearest railway station. Neither stone quarries nor minerals were observed. Game is becoming very scarce; there are, however, a few duck and an antelope is now and again sighted in the sand hills. This township is also easily reached by good trails from Davidson and Girvin on the Canadian Northern railway. These towns find the burnt and fire-killed poplar in the sand hills the only fuel obtainable at certain seasons of the year.—*C. F. Miles, D.L.S., 1908.*

52. This township is reached from Prince Albert by following the Montreal lake surveyed trail as far as Sturgeon lake, then branching off on a trail passing through the Sturgeon Lake Indian reserve and running northwesterly as far as the lumber camps in Stump lake vicinity. It crosses this township diagonally, following the south bank of Sturgeon river. In wet seasons the trail is almost impassable west of the Indian reserve. The soil is a black loam with clay or sandy clay subsoil. This township was burned over some years ago and is now covered with standing and fallen dead poplar, green spruce, second growth poplar and brush. Hay sloughs are numerous. Sturgeon river runs diagonally across this township. Normally it is about seventy-five feet wide and four feet deep, flowing three miles per hour, but during part of June and July it flooded over its entire valley to a depth of from two to four feet. No practical power-sites were observed. Numerous small streams and lakes abound, all the water being very good. June frosts were observed and during the time of survey (June) it rained almost incessantly. Wood for fuel is plentiful. No coal or minerals were found, or stone of any value. The township appears too wet for agricultural purposes but Sturgeon valley is suitable for grazing. Moose, deer, and bear are plentiful.—*F. H. Kitto, D.L.S., 1908.*

Range 4.

5. The best route for reaching this township is by means of a good trail running from Moosejaw to Wood mountain which lies from two to three miles east of this township. The soil consists of from five to six inches of sandy loam over a clay or sandy clay subsoil, and grows good grass for grazing purposes, but the land is too rolling for cultivation in most places, and is more suitable for horse ranching purposes. The surface is rolling prairie and there is no bush of any description. Hay is rather

Range 4—Continued.

scarce but there are a few small hay meadows scattered through the township where a limited amount could be cut. Water is also rather scarce but there are several small creek beds within the township which, although they have no flowing water, retain a limited supply of water all summer in deep pools along their courses. No water-power can be developed in this township. The climate is similar to that of the Moosejaw district and summer frosts are rare. Wood for fuel can be obtained five or six miles south of this township, and lignite coal can be obtained in the township east of it. No stone or minerals were found. Antelope and jack-rabbits are to be found in this township but are not plentiful.—*R. H. Cautley, D.L.S., 1908.*

6. The route for reaching this township is by a good trail running from Moosejaw to Wood mountain, which lies about three miles east of this township. The soil consists of from four to eight inches of sandy loam over a clay or sandy clay subsoil. The west half of this township is suitable for mixed farming purposes, but the east half, which is very broken, is more suitable for ranching. The surface is rolling or gently rolling prairie, broken by deep ravines in the easterly half of the township, and there is no bush of any description to be found. There are no hay meadows, but small amounts of upland hay could be cut all through the township. Water is not very plentiful, but there are two creeks in this township, one in the east half of the township being twelve feet wide, eighteen inches deep and with a current of one mile an hour, of which the water is very slightly brackish, and which ceases flowing in July, but considerable water is retained in deep pools along its course; the other is ten feet wide and has no flowing water, but there are deep pools of fresh water all along its course. No water-power can be developed. The climate is similar to that of the Moosejaw district and summer frosts are rare. Wood for fuel can be obtained about ten miles south, and lignite coal about eight miles southeast of this township. No stone or minerals were found. Antelope and jack-rabbits were seen in this township, but are not plentiful.—*R. H. Cautley, D.L.S., 1908.*

7. The route for reaching this township is by a good trail running from Moosejaw to Wood mountain which lies from five to six miles east of this township. The soil consists of three to ten inches of sandy loam over a clay or sandy clay subsoil with stray patches in places and is suitable for mixed farming purposes. The surface varies from undulating to rolling prairie and there is no bush of any description. There are no hay meadows and hay is very scarce. Water is also rather scarce but there is a good sized creek which flows through the centre of the township entering it in section 2 and leaving it in section 31. This creek in June was twelve feet wide, eighteen inches deep with a current of one mile an hour; at the end of July it had ceased flowing, but there were deep pools of slightly brackish water all along its course. There is another small creek in the north end of the township which flows into the above mentioned creek in section 32 and has pools of fresh water along its course. No water-power can be developed. The climate is similar to that of the Moosejaw district and summer frosts are rare. Wood for fuel can be obtained about sixteen miles south and lignite coal about fourteen miles south of this township. No stone or minerals were found. Antelope and jack-rabbits are the only kinds of game but are not plentiful.—*R. H. Cautley, D.L.S., 1908.*

8. The best route for reaching this township is by a good trail running from Moosejaw to Wood mountain through township 8, range 2, from where it is necessary to branch off across open prairie to this township. There is another trail which runs from section 30 of this township to Gravelbourg, and this is the route used by the settlers, but it is farther from Moosejaw by this trail. The soil consists of from six to twelve inches of sandy loam over clay or sandy clay subsoil and is well suited for mixed farming purposes, especially adjoining the west boundary where the land is very

good. Hay is not very plentiful, but in sections 19 and 30 there is part of a large hay meadow which extends into the next township where fifty or sixty tons of good hay could be cut. Fresh water is very scarce, as there are no ponds or creeks with any water in them, but there is a good well in section 30. No water-power can be developed. The climate is similar to that of the Moosejaw district and summer frosts are rare. Wood for fuel can be obtained about twenty-two miles south and lignite coal about twenty miles south of this township. No stone or minerals were found. Antelope and jack-rabbits are the only kind of game but are not plentiful.—*R. H. Cautley, D.L.S., 1908.*

9. The best route for reaching this township is by means of the old Wood mountain trail which runs through township 9, range 3, from where it is necessary to branch off across country to this township. The soil consists largely of heavy clay or clay loam, and owing to the rolling nature of the country it is not very suitable for farming purposes but would make good ranching country in the spring and early summer, as there is good grass in this township, but water is very scarce in autumn. The surface is rolling prairie and there is no bush of any description. Hay is fairly plentiful, there being numerous small hay meadows scattered all through the township, where hay of rather poor quality could be cut. Water is very scarce, the only permanent supply being a small fresh water lake on the east boundary of section 13; in the early summer there would be plenty of water, as several small hay marshes had very soft bottoms and had only just dried up in August. No water-power can be developed. The climate is similar to that of the Moosejaw district and summer frosts are rare. Wood for fuel can be obtained about twenty-eight miles south, and lignite coal about twenty-six miles south of this township. No stone or minerals were found. Several bands of antelope were seen in this township and also some jack-rabbits, but there is no other kind of game.—*R. H. Cautley, D.L.S., 1908.*

23. The Moosejaw to Outlook branch of the Canadian Pacific railway runs diagonally through this township, entering at section 12 and leaving in section 32, so this township will be easy of access from either north or southeast. There is an elevator at Bridgeford in section 7 of the adjoining township east and there are several elevators, stores, boarding houses and livery stables in Tugaske which is located about eight miles southeast of the township. The soil in the southerly two-thirds of this township is sandy loam with a subsoil of sand, whereas the northerly third is almost entirely of sand. Part of the two northerly tiers of sections is composed of sand hills covered with low scrub. All the available homesteads in the southerly tiers are taken up, also some of the odd sections, and the soil in this part is suitable for the raising of all kinds of cereals. The greater portion of the township consists of open undulating prairie. The northerly and northeasterly portion, however, is hilly and in some places covered with willow, but there is no timber to be found of any account. There are but few hay meadows, most of the hay being cut on the uplands. The water in the pools and marshes is mostly alkaline but wells dug by settlers contain fairly good fresh water. Qu'Appelle river rises in this township in a lake situated in the northeast corner of section 26, from here the water runs both southeasterly down the Qu'Appelle valley and northwesterly under the name of Aiktow creek into Saskatchewan river. There are no available water-powers. I understand that there are no summer frosts and the crops at the time of the survey, in June, looked very promising. There is no fuel and much of the wood hitherto used as fuel has been obtained from the sand hills to the northeast of this township, but from all appearances, at the rate the timber is being cut, it will not hold out another winter. Coal will, no doubt, be obtainable at all the stations on the new line as soon as the steel is laid. There are no stone quarries of any description and no minerals. There are still a few prairie

TOWNSHIPS WEST OF THE THIRD MERIDIAN.

Range 4—Continued.

chickens to be seen and occasionally an antelope, but all game will soon be exterminated. This township is about as well settled as it is likely to be as most of the odd sections that are of any value have been pre-empted by the settlers.—*C. F. Miles, D.L.S., 1908.*

24. This township is reached by a good trail from Elbow, a station on the Moosejaw to Outlook branch of the Canadian Pacific railway, which passes through the west half of the township. Owing to the lateness of the season, the pits were not dug but the soil appears to be light all through the central portion. A continuation of the sand hills along the banks of the Qu'Appelle valley covers the southern part of the township, which with a good growth of willow, scrub and some second growth poplar make this part of the township of little value, except for grazing purposes. Except the sand hills it is mostly undulating and light rolling prairie. There are some hay marshes but the bulk seems to be cut in the upland and in the Aiktow valley in dry seasons. Summer frosts on the light soils appear to be not so general as they are on heavier soils. Fuel may be had in the sand hills where there is still some firekilled poplar, but now that the railway is so convenient, no doubt, coal will be more generally used. There were no stone quarries nor any minerals observed. Game is getting very scarce, this and the adjoining townships being too thickly settled. Only two years ago, antelopes and deer were quite plentiful but only an occasional one is now seen. There are still a few prairie-chickens to be met with and coyotes are quite a common sight in the hills. The building of the new railroad has given a great impetus to the settlement of this district. A number of small towns have sprung up. Elbow, being the closest of any size to this township, is used by settlers in this vicinity as a supply and shipping point. This settlement contains banks, hotel, elevators, postoffice and all kinds of stores. Aiktow station is in section 5 of this township and could be used as a shipping point but will not amount to anything, on account of its location in the sand hills.—*C. F. Miles, D.L.S., 1908.*

52. This township is reached from Prince Albert by a trail which crosses the northern part of the township, leading to the lumber camps in the vicinity. It is almost impassable except when frozen. The township is covered with heavy spruce, poplar, tamarack and birch, with thick underbrush in places. The best spruce is being cut out. The surface is fairly level but badly broken by a chain of lakes extending diagonally across the township from the northwest to the southeast, by Sturgeon river crossing the northeast corner and by numerous small lakes, muskegs and large sloughs The soil is a black loam with clay subsoil. No hay is to be found. The water of the lakes and rivers is good. Wood for fuel or building is plentiful but no coal, stone or minerals were found. June frosts were observed. The township appears too wet and swampy to be suitable for settlement or grazing. Fish are plentiful in the lakes; moose, deer and bear were seen.—*F. H. Kitto, D.L.S., 1908.*

Range 5.

5. The best route for reaching this township is by means of a good trail running from Moosejaw to Wood mountain through township 5, range 3, from where it is necessary to branch off through rolling prairie to this township. The soil consists of from four to eight inches of sandy loam over a sandy clay subsoil and, where not too rolling, is suitable for mixed farming purposes. The surface is rolling or gently rolling prairie and there is no bush of any description. Hay is rather scarce as there are no hay meadows, but small amounts of upland hay could be cut all through the township. Water is fairly plentiful and the supply is permanent, being furnished by one flowing creek in the west part of this township, which is five feet wide, six inches deep and

has a current of one mile an hour; this creek does not flow all summer, but there are permanent pools of fresh water all along its course. There are also small creek beds with no flowing water but with occasional permanent pools of fresh water along their courses, all through the township. No water-power can be developed. The climate is similar to that of the Moosejaw district and summer frosts are rare. Wood for fuel can be obtained in the hills about eight miles south, but there are no coal veins in this township. No stone or minerals are to be found. Antelope and jack-rabbits are the only kinds of game in this neighbourhood.—*R. H. Cautley, D.L.S., 1908.*

6. The route for reaching this township is by a good trail running from Moosejaw to Wood mountain through township 6, range 3, from where it is necessary to branch off through rolling prairie to this township. The soil consists of from six to twelve inches of light sandy loam over a clay or sandy clay subsoil, and is suitable for mixed farming purposes. The surface is undulating or gently rolling prairie and there is no bush of any description. There are no hay meadows, but small amounts of upland hay could be cut all over the township. Water is rather scarce; there are two creeks in the township neither of which has any flowing water, but both retain a limited supply of fresh water all summer in deep pools along their beds. No water-power can be developed. The climate is similar to that of the Moosejaw district and summer frosts are rare. Wood for fuel can be obtained about fourteen miles south, but there are no coal veins in this township. No stone or minerals were found. Antelope and jack-rabbits were seen, but are not plentiful.—*R. H. Cautley, D.L.S., 1908.*

7. The route for reaching this township is by a good trail running from Moosejaw to Wood mountain through township 7, range 3, from where it is necessary to branch off across open prairie to this township. The soil consists of from three to six inches of sandy loam over a sandy clay subsoil mostly, and is suitable for mixed farming purposes, but in the northwest quarter of the township the soil is a heavy clay and should make good wheat land. The surface is generally undulating prairie but there is a good stretch of nearly level prairie adjoining Wood river in the northwest quarter of the township, and there is no bush of any description. There are no hay meadows but small amounts of upland hay could be cut in places. Water is plentiful and the supply permanent, being furnished by Wood river which is twelve feet wide, eighteen inches deep, with a current of two miles an hour and contains fresh water, also two other creeks, one twelve feet wide, eighteen inches deep and with slightly brackish water, the other ten feet wide and with fresh water, both these creeks had stopped running in July, but retained a permanent supply of water in deep pools all along their courses. Wood river also ceases flowing in the autumn, but large and deep pools of water remain all along its course. No water-power can be developed. The climate is similar to that of the Moosejaw district and summer frosts are rare. Wood for fuel can be obtained about twenty miles south of this township, but there are no coal veins in the vicinity. No stone or minerals were found. Antelope and jack-rabbits are the only kinds of game, but are not plentiful.—*R. H. Cautley, D.L.S., 1908.*

8. The best route for reaching this township is by a fairly good trail which runs from Gravelbourg into the northeast corner. The soil consists generally of from six to twelve inches of sandy loam over a clay or sandy clay subsoil, and is well suited for mixed farming purposes, and, adjoining Wood river in the west part of the township, there is some heavy clay soil which would make good wheat land. The surface is undulating or gently rolling prairie and there is no bush of any description. There is a large hay meadow in sections 23, 24, 25 and 26, where nearly a thousand tons of good hay could be cut. The supply of fresh water is fairly

Range 5—Continued.

plentiful and permanent, being furnished by Wood river, which is twenty-five feet wide, two feet deep and has a current of one mile an hour. This stream ceases flowing in the autumn, but there are large and deep pools all along its course which retain a permanent supply of water. No water-power can be developed. The climate is similar to that of the Moosejaw district and summer frosts are rare. Wood for fuel can be obtained about twenty-six miles south of this township, but there are no coal veins in this vicinity. No stone or minerals were found. Antelope and jack-rabbits are the only kinds of game, but are very scarce.—*R. H. Cautley, D.L.S., 1908.*

9. The best route for reaching this township is by means of a trail running from Gravelbourg to township 8, range 5, which passes through this township entering it in section 36 and leaving it in section 2. The soil consists of from three to six inches of dark sandy loam, over a clay or sandy clay subsoil and it is well suited for mixed farming purposes, especially in the west two miles of the township, where there is some very good land. The surface is undulating or rolling prairie with a few small clumps of willow and maple scrub along the banks of Wood river. There are several small hay meadows in the east end of the township where a considerable amount of good hay can be cut, and in sections 18 and 19 there is part of a large hay meadow which extends over into the next township where probably forty to fifty tons of good hay can be cut. The supply of fresh water is plentiful and permanent, being furnished by Wood river which enters this township in section 6 and leaves it in section 36. It is twenty-five feet wide and two feet deep. The river had stopped flowing by August 7, but a permanent supply of fresh water was retained in deep and large pools all along its course. No water-power can be developed. The climate is similar to that of the Moosejaw district and summer frosts are rare. Wood for fuel can be obtained in very small quantities along the river banks, but for good wood it is necessary to go about thirty-two miles south of this township. There are no coal veins in this vicinity. No stone or minerals were found. Antelope and jack-rabbits are the only kinds of game, but are not plentiful.—*R. H. Cautley, D.L.S., 1908.*

Range 6.

5. The route for reaching this township is by a good trail running from Moosejaw to Wood mountain through township 5, range 3, from where it is necessary to branch off through rolling prairie to this township. The soil consists of from three to twelve inches of sandy loam over a sandy clay subsoil, and is suitable for mixed farming. The surface is undulating or gently rolling prairie in the north half of the township, but is more rolling farther south, and there is no bush of any description. Hay is rather scarce as there are no hay meadows, but small amounts of upland hay could be cut all through the township. Water is fairly plentiful and the supply is permanent being furnished by Wood river in the northwest and a flowing creek in the northeast of this township. Wood river is twelve feet wide eighteen inches deep, with a current of two miles an hour, and the creek in the northeast corner of the township is five feet wide six inches deep and has a current of one mile an hour; both these streams cease flowing in the fall of the year but a permanent supply of fresh water is retained in deep pools along their courses. There are also other small creek beds with no flowing water but with occasional permanent pools of fresh water along their courses. No water-power can be developed. The climate is similar to that of the Moosejaw district and summer frosts are rare. Wood for fuel can be obtained in the hills about ten miles south of this township, but there are no coal veins in this township. No stone or minerals were found. Antelope and jack-rabbits are the only kinds of game in this neighbourhood.—*R. H. Cautley, D.L.S., 1908.*

Range 6—Continued.

6. The route for reaching this township is by a good trail running from Moosejaw to Wood mountain through township 6, range 3, from where it is necessary to branch off through rolling prairie to this township. The soil consists of from six to twelve inches of sandy loam over a clay or sandy clay subsoil and this township, especially the western half, is well suited for mixed farming. The westerly half is undulating prairie but the easterly half is more rolling; there is no bush of any description. Hay is rather scarce, but small amounts of upland hay could be cut all through the township. Fresh water is plentiful and the supply permanent being furnished by Wood river and creek which flows into Wood river in section 33. Wood river is twelve feet wide, eighteen inches deep with a current of two miles an hour, and the other creek is five feet wide, six inches deep, with a current of one mile an hour. Both these streams cease flowing in the autumn but a permanent supply of water is retained in deep pools along their courses. No water-power can be developed. The climate is similar to that of the Moosejaw district and summer frosts are rare. Wood for fuel can be obtained about sixteen miles south but there are no coal veins in this township. No stone or minerals were found. Antelope and jack-rabbits were seen but are not plentiful.—*R. H. Cautley, D.L.S., 1908.*

7. The route for reaching this township is by a good trail running from Moosejaw to Wood mountain through township 7, range 3, from where it is necessary to branch off across open prairie to this township. The soil in the greater part of this township consists of a gray chalky clay which does not look very productive, but there is some good land adjoining the south and west boundaries with a sandy loam soil over a sandy clay subsoil which would be suitable for mixed farming purposes. The surface is level to undulating prairie and there is no bush of any description. There are no hay meadows and very little upland hay could be cut. The supply of fresh water is fairly plentiful and permanent, being furnished by Wood river which is twelve feet wide, eighteen inches deep, and has a current of two miles an hour. This stream ceases flowing in the autumn, but a permanent supply of water is retained in large and deep pools along its course. No water-power can be developed. The climate is similar to that of Moosejaw district and summer frosts are rare. Wood for fuel can be obtained about twenty-two miles south of this township, but there are no coal veins in this vicinity. No stone or minerals were found. A few sage grouse were seen, but there are no other kinds of game.—*R. H. Cautley, D.L.S., 1908.*

8. The best route for reaching this township is by a trail which runs from Gravelbourg on the west side of Wood river, this trail is fairly good and well defined as far as section 30 in township 9, range 5, from where it branches off in all directions, but the prairie is not hilly and is very easy to travel over. The soil consists of from six to twelve inches of sandy loam over a clay subsoil and is well suited for mixed forming purposes. The surface is undulating or gently rolling prairie and there is no bush of any description. Hay is not plentiful, but there are a few small hay meadows scattered through the township where small amounts of hay of rather poor quality could be cut. The supply of fresh water is fairly plentiful and permanent, being furnished by Pinto creek which flows into Wood river in section 24, and also by Wood river, which passes through sections 24, 25 and 36. Pinto creek was quite dry in places in July, but there are deep and large pools at intervals all along its course, some being as large as one chain wide and five feet deep. Wood river is twenty-five feet wide, two feet deep and has a current of one mile an hour. This stream stops flowing in the autumn, but retains a permanent supply of water in deep pools along its course. No water-power can be developed. The climate is similar to

Range 6—Continued.

that of the Moosejaw district and summer frosts are rare. Wood for fuel can be obtained about twenty-eight miles south of this township, but there are no coal veins in this vicinity. No stone or minerals were found. Antelope and jack-rabbits are the only kinds of game, but they are scarce.—*R. H. Cautley, D.L.S., 1908.*

9. The best route for reaching this township is by means of a trail which runs from Gravelbourg to section 25 of this township; it is not a very good trail as it has not been travelled very much, but it runs through fairly level country all the way; from section 25 there are tracks running to the different settlers' homes but none of importance. The soil consists of from four to eight inches of dark sandy loam over a clay subsoil and is well suited for mixed farming purposes. The surface is undulating prairie and there is no bush of any description. There is a large hay meadow in sections 14 and 24 which is wet and marshy in the centre and on which over a hundred tons of good hay could be cut, but there is very little hay in other parts of the township. Water is very scarce, there being no creeks or ponds and the settlers were getting their water from a good well in section 15. No water-power can be developed. The climate is similar to that of the Moosejaw district and summer frosts are rare. Wood for fuel can be obtained about thirty-four miles south of this township, but there are no coal veins in this vicinity. No stone or minerals were found. Antelope and jack-rabbits are the only kinds of game, but are very scarce.—*R. H. Cautley, D.L.S., 1908.*

10. The best route for reaching this township is by means of a trail which runs from Gravelbourg and follows along the correction line to the home of a settler in section 36 of this township. The trail is rather rough not having been travelled much but runs through very level country. The soil consists of four to twelve inches of sandy loam over a clay or sandy clay subsoil and owing to the rolling nature of the country this township is more adapted to ranching purposes than farming but there are a few sections that would be suitable for mixed farming purposes. The surface is rolling or gently rolling prairie, and there is no bush of any description. Hay is fairly plentiful, there being several good sized hay meadows scattered all through the township, where hay of rather poor quality can be cut, the largest of these hay meadows in section 19 would probably furnish forty tons of hay. Water is very scarce in this township there being no ponds or creeks in it, but several of the hay meadows have some fresh water in them. No water-power can be developed. The climate is similar to that of the Moosejaw district, and summer frosts are rare. Wood for fuel can be obtained about forty miles south of this township, but there are no coal veins in this vicinity. No stone or minerals were found. Several small herds of antelope were seen and some jack-rabbits but there are no other kinds of game.—*R. H. Cautley, D.L.S. ,1908*

Range 7.

5. The best route for reaching this township is by a good trail running from Moosejaw to Wood mountain through township 5, range 3, from where it is necessary to branch off through rolling prairie to this township. The soil consists of from six to eighteen inches of dark sandy loam over a sandy clay subsoil and is well suited for mixed farming purposes. The surface is undulating prairie and no bush of any description is to be found. Hay is rather scarce as there are no hay meadows, but small amounts of upland hay could be cut all through the township. Water is fairly plentiful and the supply is permanent being furnished by Wood river which is twelve feet wide eighteen inches deep and has a current of two miles an hour. This stream stops flowing in the fall of the year but a permanent supply of fresh water is retained

Range 7—Continued.

in deep pools along its course. There are also two other fair sized creek beds with no flowing water but with permanent pools along their courses. No water-power can be developed. The climate is similar to that of the Moosejaw district and summer frosts are rare. Wood for fuel can be obtained in the hills, ten to fifteen miles south of this township, but there are no coal veins in the vicinity. No stone or minerals were found. Antelope and jack-rabbits were seen but are not plentiful.—*R. H. Cautley, D.L.S., 1908.*

6. The route for reaching this township is by a good trail running from Moosejaw to Wood mountain, through township 6, range 3, from where it is necessary to branch off across country to this township. The soil consists of from six to eighteen inches of sandy loam over sandy clay subsoil and is well suited for mixed farming purposes. The surface is undulating or gently rolling prairie, and there is no bush of any description. There are no hay meadows but small amounts of upland hay could be cut all through the township. Water is very scarce, the only source of supply being a small creek in the extreme south of this township; it has very little running water, but has deep pools of fresh water all along its course. No water-power can be developed. The climate is similar to that of the Moosejaw district, and summer frosts are rare. Wood for fuel can be obtained about eighteen miles south but there are no coal veins in this vicinity. No stone or minerals were found. Antelope and jack-rabbits were seen but are not plentiful.—*R. H. Cautley, D.L.S., 1908.*

7. The soil in the northwest portion of this township is usually a brown loam and clay subsoil, but in the southeast part it is quite sandy in places along a ridge near the east side. It would make fair farm land, and is very good for grazing. The surface of the northwest part is gently rolling bare prairie, while that of the south-easterly portion is more rolling with a few sand hills towards the east. There is no timber and very little hay. There is no water in this township and no water-powers. The land is not liable to be flooded. The climate was hot with some heavy rain and very high winds; no summer frosts were noticed. There is no fuel, stone quarries or minerals, and the only game seen was antelope.—*W. G. McFarlane, D.L.S., 1908.*

8. The soil across the centre of this township from sections 7 and 18 to sections 24 and 25 is mostly a heavy clay in the Pinto creek flat. It was a shallow lake bottom at one time, but is now dry and rough. North and south of this the soil is a sandy loam with clay subsoil, and this part of it would make good farm land. The flat has considerable hay on it and makes fair grazing land. The surface is flat across the centre but bare rolling prairie to the north and south. There is no timber and hay is not very plentiful. Water is scarce but alkaline pools are still found in the Pinto creek bed; some squatters towards the north side of the township have wells with good water. The flat may be flooded in the spring but not likely over a foot deep. There are no water-powers. The climate was warm, and no frosts were noticed. There is no fuel, stone quarries or minerals, and the only game seen was antelope. Until the end of June rain fell fairly frequently and there was usually heavy dew. This kept the grass green all over the prairie, but in July, rains were less frequent and scorching hot dry winds were almost continuous for some days so that the grass soon becomes brown and dry.—*W. G. McFarlane, D.L.S., 1908.*

9. The soil of this township is a brown clay loam with a few stony places, but would make good farm land if there was plenty of rain. The surface is all bare rolling prairie, but towards the southeast it is fairly level and would make fine farm land. There is no timber and very little hay. A little might be cut in some of the sloughs here and there throughout the township. The water is usually fresh but there are

Range 7—Continued.

some places with white alkali. There is plenty of water in the spring but it would be very scarce in the summer. There are on streams nor water-power and the land is not liable to be flooded. The climate was cool and quite a lot of rain fell. Some hard frosts were noticed. There is no fuel, stone quarries or minerals. The only game seen was antelope and duck.—*W. G. McFarlane, D.L.S., 1908.*

10. The route followed was from Moosejaw to Johnston lake, thence westerly by trail to township 10, range 6. The trail then followed the correction line west to township 10, range 7, and is all good. The soil is a brown clay loam and would make very good farm land if there was plenty of rainfall. The surface is all bare prairie, but there are some gravelly and stony ridges. The land is gently rolling with a ridge running across the southern half just south of the south chord. There is no timber. A few hay sloughs are found in sections 20, 21 and 29 but are not of much account as it is coarse slough hay. The water is generally fresh. There are many small fresh-water sloughs and a few fair sized fresh water lakes which dry up. One large slough in section 16 has alkaline water and is surrounded by reeds. It would probably dry up in some dry seasons. The supply was sufficient at the time of survey (May), but it would be all gone in a few months. There are no streams nor water-powers and the land is not liable to be flooded to any great extent. The climate was cool, except during a few days, and considerable rain fell. A few hard frosts were noticed. There is no fuel, stone quarries or minerals. The only game seen was antelope and duck.—*W. G. McFarlane, D.L.S., 1908.*

Range 8.

5. The soil is a brown loam and clay subsoil in general, but there are quite a lot of stones throughout the greater part of the township, as well as several scattered alkaline flats. It would make fair farm land but is better for grazing. The surface is all bare prairie, gently rolling on the west half, and the north side except at the northwest corner which is a little hilly. The east part of the township is more hilly, although not very abrupt. There is no timber and very little hay, but the grass was fairly good. Water is fairly plentiful in McDonald creek which crosses the north side of the township, but has stopped running now (July). The water in the pools is fairly good, but a little alkaline. There is a large shallow slough on the east boundary of section 3. The land is not liable to be flooded, and water will be rather scarce later in the season. There are no water-powers. The weather was very hot, with some thunderstorms, and scorching hot winds. No frosts were noticed. There is no fuel, stone quarries or minerals, and the only game seen was antelope. A good trail runs westerly to Wood mountain across the township near the north chord.—*W. G. McFarlane, D.L.S., 1908.*

6. The soil is a brown loam with clay subsoil. Considerable scattered stone is found, but this would not hurt it for farm land very much. It would make either good farm land or grazing land and it seems to have a better growth of grass than the rest of the township to the north of it. The surface is mostly gently rolling bare prairie, but the southeast quarter of the township as well as a few sections at the south end of the west boundary are somewhat hilly. There is no timber and very little hay. Water is rather scarce and somewhat alkaline. McDonald creek crosses the southeast corner, but it is drying up and has scarcely any current now. A little water was found in a coulée at the north side of the township. It was fairly fresh, but would soon all be dried up. Water will be very scarce in the fall. The land is not liable to be flooded, and there are no water-powers. The weather was warm, with some rain and high winds. No frosts were noticed. There is no fuel, stone quarries

Range 8—Continued.

or minerals in the township, and the only game seen was antelope. Hot winds have a very bad effect as they soon dry all the water up and scorch the grass too early in the summer.—*W. G. McFarlane, D.L.S., 1908.*

7. The soil is in general a brown loam with clay subsoil and would make fair farming or grazing land. The surface of the easterly part is very slightly rolling, while that to the west with the exception of a portion along the south of Pinto creek is rolling, but near the creek it is rather hilly. It is all bare prairie with no timber and no hay. Water is very scarce except in Pinto creek, which runs across the northwest corner of the township; it is rather alkaline and has almost stopped running. The land is not liable to be flooded and there are no water-powers. The climate was warm and dry with high winds. No frosts were noticed. There is no fuel, stone quarries or minerals and the only game seen was antelope.—*W. G. McFarlane, D.L.S., 1908.*

8. The soil in the southeast quarter of this township is a heavy clay and would not make very good farm land, but makes fair grazing land. The other parts of the township have a brown loam and clay subsoil with some stones in the northeast quarter, and some alkaline clay flats in the west half. Much of it would be good farm or grazing land. The surface is all bare prairie. The southeast quarter is mostly a river flat with some alkali and a strip runs up through sections 20 and 19. The west half is mostly rolling with a few alkaline flats, while the northeast quarter is rather hilly and stony. There is no timber and very little hay. The water is rather alkaline and is very scarce, except in Pinto creek, but even this is getting low. However, there will likely be water in the pools most of the summer. The river flat might be flooded in early spring but not to any great depth. There are no water-powers. The climate was warm and dry with high winds, and no frosts were noticed. There is no fuel, stone quarries or minerals, and the only game seen was antelope.—*W. G. McFarlane, D.L.S., 1908.*

9. The soil is a brown clay loam and would be fairly good for farm land. The surface is all gently rolling bare prairie. There is no timber and very little hay. The water is fresh and is rather plentiful in small sloughs in the spring but would all dry up during the summer. There are no streams and the land is not liable to be flooded. There are no water-powers. The climate was usually cool, but some hot days were experienced and considerable rain fell. Some hard frosts were noticed. There is no fuel, stone quarries or minerals and the only game found was antelope. —*W. G. McFarlane, D.L.S., 1908.*

10. The soil is a brown clay loam with considerable gravel and stones on some ridges towards the south. The surface is all bare prairie, fairly level towards the north, but rolling and hilly towards the southwest. There is no timber and very little hay. A large slough, nearly dry, runs into the northwest corner and it might have some coarse hay. The water is fresh but is rather scarce and will have all disappeared before the season is over. There are no streams and the land is not liable to be flooded. There are no water-powers. The climate is usually cool and considerable rain fell. Some hard frosts were noticed. There is no fuel, stone quarries or minerals. The only game seen was antelope. All this part of the prairie is good grazing land and would also make fair farm land.—*W. G. McFarlane, D.L.S., 1908.*

Range 9.

7. The soil of this township is usually a brown loam with clay subsoil, but from the centre of the township north, the surface is flat, and the soil is heavy clay in sections 27, 28 33 and 34. It would make good farm land if it had plenty of rain, and is

Range 9—Continued.

now good for grazing. The surface is gently rolling around the boundary line and the south third of the township, and slopes off to a flat at the centre of the north side. It is all bare prairie. There is no timber and no hay. The water is fairly good, but a little alkaline. Pinto creek runs across the north side of the township and a tributary creek comes in through sections 18, 17, 16, 22 and 27. Pinto creek is barely running and will soon be only a series of pools. There are no water-powers and the land is not liable to be flooded. The weather was usually warm and dry with high winds. No frosts were noticed. There is no fuel, stone quarries or minerals, and the only game seen was antelope.—*W. G. McFarlane, D.L.S., 1908,*

8. The soil is chiefly a brown loam and a clay subsoil, but some flats of rather hard clay are found in the northeast quarter of the township. The surface is all bare rolling prairie with the highest elevation running easterly across the centre of the township. A valley runs easterly across the north part of the township. There is no timber and very little hay. Water is very scarce, but there is a little in the valley to the north. It is fairly fresh, but there are some alkaline flats. Pinto creek touches the southwest corner and the water might flow easterly along the valley to the north and flood part of the flats but not to any great depth. There are no water-powers. The weather was warm and dry with high winds. No frosts were noticed. There is no fuel, stone quarries or minerals, and the only game seen was antelope.—*W. G. McFarlane, D.L.S., 1908.*

9. The soil is light sandy clay loam, and would be fairly good farm land if there was plenty of rainfall. The surface is bare, gently rolling prairie to the north and bare rolling prairie to the south. There is no timber. A little hay is found at the north boundary, but it is not plentiful. The water is usually fresh, but there are some alkaline streaks in the hollows towards the south. Water is scarce and it will soon be all gone. There are no streams and the land is not liable to be flooded. There are no water-powers. The climate was usually warm, with occasional rainfalls. No frosts were noticed. There is no fuel, stone quarries or minerals. The only game seen was antelope.—*W. G. McFarlane, D.L.S., 1908.*

10. The soil in this township is a brown clay loam and clay subsoil and would make fair farm land. The surface is bare prairie, gently rolling towards the north and west, and rather hilly towards the southeast. There is no timber and very little hay; a little might be cut on the sloughs in the southeast corner; but it would not amount to much. The water is fresh, but rather scarce. Some small sloughs are found towards the south and east, but they will soon dry up. There are no streams and the land is not liable to be flooded. There are no water-powers. The climate was usually warm and some rain fell. No frosts were noticed. There is no fuel, stone quarries or minerals. The only game seen was antelope.—*W. G. McFarlane, D.L.S., 1908.*

Range 10.

5. (East outline.) The soil is a light clay or slightly sandy with clay subsoil, and would make good farming land. The surface is rolling bare prairie, slightly hilly at the south side. There is no timber. Some hay meadows were seen, but it was only slough hay. A small permanent creek containing very good water, running east crosses about one mile from the base line. There is no danger from floods and no water-power is available. There is no fuel, stone quarries or minerals. The climate was warm and dry. The only game seen was antelope.—*W. G. McFarlane, D.L.S., 1908.*

Range 10—Continued.

6. (East outline.) The soil is a clay loam with clay subsoil, and would make very fair farm land. The surface is gently rolling, bare prairie, with no timber and but little hay. No water was found and the land is not liable to be flooded. There is no water-power, fuel, stone quarries or minerals. The climate was warm and dry. Antelope was the only game seen.—*W. G. McFarlane, D.L.S., 1908.*

7. The soil is usually a brown loam with clay subsoil, and would make good farming or grazing land. The surface is bare rolling prairie in general, but is rather hilly at the centre and southeast of the township. The hills are somewhat stony, but not very abrupt or high. There is no timber and very little hay. The water is fairly good in Pinto creek, which runs easterly across the north end of the township, and in a small creek crossing the southeast corner. There is plenty just now (June) but it will be scarce later in the summer. Pinto creek is from two to fifteen feet wide and one to four feet deep, but has very little current. A creek at the southeast corner is scarcely more than a series of pools now. There is some alkali. The land is not liable to be flooded. There are no water-powers. The climate was warm with a little rain and a hurricane or two, but no frosts. There is no fuel, stone quarries or minerals, and the only game seen was antelope.—*W. G. McFarlane, D.L.S., 1908.*

8. The soil is chiefly a brown loam with a clay subsoil and would make very good farm or grazing land. Some alkali is found in small flats and small creek bottoms. The surface is all bare, rolling prairie. Along the south side, several small coulées run down to Pinto creek and break the surface up somewhat. Some of these are rather gravelly and stony on the banks. There is no timber and very little hay. The water is not very plentiful and is very alkaline in the bed of a small stream which runs into Pinto creek, but is drying up and is now (June) only a series of pools at the south side of the township. It is rather better in Pinto creek at the south boundary of section 3. Pinto creek is from two to twenty feet wide and from one to five feet deep with but little current and will likely soon stop running. The land is not liable to be flooded and there are no water-powers. The climate was warm and high winds were frequent. We had a little rain but no frosts. There is no fuel, stone quarries or minerals. The only game seen was antelope.—*W. G. McFarlane, D.L.S., 1908.*

9. The soil of this township is a clay loam with clay subsoil and would make fairly good farm land. The surface is bare rolling prairie. There is no timber and no hay. The water is a little alkaline and rather scarce but some is found in creek beds in pools. There are no streams and the land is not liable to be flooded. There are no water-powers. The climate was warm and there was some rain but no frosts. There is no fuel, stone quarries or minerals. The only game seen was antelope.—*W. G. McFarlane, D. L. S., 1908.*

10. The soil of this township is mostly a good clay loam and would make good farm land. The surface is usually gently rolling bare prairie, but is broken on the west side by Notukeu creek which enters in section 18, and runs north along the west meridian. There is no timber and no hay. The water is a little alkaline in small sloughs in creek beds and in the large creek. It will all dry up except the large creek in the summer and even it is said to stop running but to hold water in the deep pools It is about a chain wide and from one to five feet deep with a current of about one mile per hour. The land is not liable to be flooded. There are no water-powers. The climate was warm and we had some rain but no frosts. There is no fuel, stone quarries or minerals. The only game seen was antelope.—*W. G. McFarlane, D.L.S., 1908.*

TOWNSHIPS WEST OF THE THIRD MERIDIAN.

Range 11.

5. (East outline). The soil is light clay or sandy loam with clay subsoil and is good farming land. It is gently rolling prairie with no timber. A few hay sloughs were seen. Fresh water was found in sloughs and in a small creek running west two and one-quarter miles from the base line. There is no water-power, fuel, stone quarries or minerals, and the only game seen was antelope. It is also good grazing land. —*W. G. McFarlane, D.L.S., 1903.*

6. (East outline). The soil is a light clay or sandy loam with clay subsoil and is good farming land. The surface is bare rolling prairie with some small ridges which are a little stony. There is no timber and very little hay. Water is rather scarce and the supply very limited. At three-quarters of a mile north, on the east boundary of section 25, a small creek of fresh water crosses, running east. It is liable to dry up in the fall. The land is not liable to be flooded. The climate was warm and dry. No fuel, stone quarries or minerals were found, and the only game seen was antelope. —*W. G. McFarlane, D.L.S., 1903.*

7. The soil is usually a brown loam with clay subsoil, but considerable gravel is found along the banks of the coulées and heavy clay along the flats. The upland would make very good farm or grazing land. The surface is bare rolling prairie, but is pretty badly broken up in places by coulées. Pinto creek runs from the southwest corner to the northeast, and side coulées running into the main coulée are very numerous on the north side. Some of them have pools of water in them. There is no timber or hay. The water is quite alkaline, but is fairly plentiful at present (June.) It is found in Pinto creek and in pools in the side coulées. There are two streams forming Pinto creek, one from the west and one from the south, joining in section 8. Pinto creek is small and scarcely running and will be nothing but a series of pools in a short time. The land is not liable to be flooded. There are no water-powers. The climate was warm with some heavy rain and high winds, but no frost. There is no fuel, stone quarries or minerals and the only game seen was antelope. —*W. G. McFarlane, D.L.S., 1903.*

8. The soil is chiefly a brown loam with clay subsoil and would make very good farm land if there was sufficient rainfall. It is very good for grazing. It is rather stony in the southwest corner. The surface is mostly gently rolling, bare prairie, but is rather broken along the south side by a coulée running south and east towards Pinto creek. One coulée comes in on the west boundary of section 7 and goes out on the south of 3, running nearly straight across. It varies from forty to one hundred feet in depth. Section 1 is badly broken by coulées. There is no timber or hay and very little water, but some is found in the large coulée and it is fairly fresh, The supply is very limited and not permanent. There are no streams and the land is not likely to be flooded. There are no water-powers. The climate was warm with some rain and high winds, but no frost. There is no fuel, stone quarries or minerals and the only game seen was antelope.—*W. G. McFarlane, D.L.S., 1903.*

9. The soil is chiefly a brown loam with clay subsoil, but is a little gravelly and stony in places along the coulée by Notukeu creek. It would make good farm land. The surface is all bare prairie and is gently rolling, except in the northwest quarter of the township. Notukeu creek comes in from the west at the north boundary of section 19, and runs easterly about three miles, then north, and breaks this corner up somewhat with fairly deep coulées. There is no timber and no hay. The water is scarce, except in the creek which is about two feet deep, one chain wide and has a current of about one mile per hour. The land is not liable to be flooded. There are

Range 11—Continued.

no water-powers. The climate was usually warm with considerable rain and very often high winds. No summer frosts were noticed. There is no fuel, stone quarries or minerals, and the only game seen was antelope.—*W. G. McFarlane, D.L.S., 1908.*

10. The soil is chiefly a good brown loam with clay subsoil and very good for farm land. The surface is broken across the south by the coulée along Notukeu creek, but is gently rolling north of the creek. It is all bare prairie. There is no timber and no hay. The water is somewhat alkaline and is very scarce, except in the creek. The creek is said to stop running in the summer, but has water in holes. It is about one chain wide, two feet deep and has a current of about one mile per hour. The land is not liable to be flooded. There are no water-powers. The climate was usually warm with occasional showers and many high winds. No frosts were noticed. There is no fuel, stone quarries or minerals and the only game seen was antelope.—*W. G. McFarlane, D.L.S., 1908.*

Range 12.

5. (East outline.) The north part of this line is sandy loam and clay and is suitable for farming or grazing as it is gently rolling prairie except the first three and one-half miles which are very rough and hilly, but have fairly good grass. There is no timber, nor hay to any extent. There is no surface water and no water-powers. The climate was warm with some rain, but no frosts. There is no fuel, stone quarries or minerals, and the only game seen was antelope.—*W. G. McFarlane, D.L.S., 1908.*

6. (East outline.) The soil is light clay loam and clay subsoil, suitable for farming or grazing. The surface is gently rolling prairie, with no timber, but there are some hay meadows. A branch of Pinto creek crosses the east boundary of section 12, running east. The water is slightly alkaline and the creek is almost dry although the supply of water would likely be permanent. The land is not liable to be flooded and there is no water-power, fuel, stone quarries or minerals. The only game seen was antelope.—*W. G. McFarlane, D.L.S., 1908.*

7. The soil in this township is chiefly a loam with a clay subsoil with the exception of some ridges which are gravelly and stony and some coulées which have some alkaline flats of heavy clay and considerable stone. The northeast quarter of the township would make very good farm land as also part of the southeast quarter. However, the latter is broken considerably by a big coulée with several side coulées running into it. The west half is very rough and almost entirely very hilly. No very large hills are found but almost continuous small ones. It is also considerably higher than the east side and the general slope is towards the southeast. About two-thirds of the township would be fit only for grazing. There is no timber and no hay. The water is rather alkaline and is only found in holes in a creek bed in the big coulée which runs out to the east on the east boundary of section 1 and in a large slough near the centre of the township. The creek rises near the west side of the township and flows easterly, going out at the east boundary of section 1. The water supply is not likely permanent as the creek had almost stopped running at the east boundary and water is not at all plentiful. The land will not be flooded. There are no water-powers. The climate was warm with some winds and some heavy rain. There is no fuel, stone quarries or minerals and the only game seen was antelope.—*W. G. McFarlane, D.L.S., 1908.*

8. The soil in this township is a brown sandy loam with clay subsoil, in general, but a few flats with clay and alkali, and ridges with gravel are found. It would make fair farm land except in a section or two at the southwest corner, which are

Range 12—Continued.

quite rough and hilly. The rest of the surface is rolling, with the creek valley running north through the centre. There is no timber and no hay. The water is rather alkaline, except in the pools near the head of the streams, where it is fresh and good. The surface water would likely all dry up in the summer. The land is not liable to be flooded. There are no water-powers. The climate was usually warm, but we had considerable rain, wind and some frost. There is no fuel, minerals or stone quarries. The only game seen was antelope.—*W. G. McFarlane, D.L.S., 1908.*

9. The soil in this township is a brown loam with clay subsoil and will make good farm land. The surface is all gently rolling bare prairie. There is no timber or hay. The water is a little alkaline and is scarce, except in the creek or creek beds. One branch of the Notukeu creek runs across the north part of the township, and is about eighty links wide, one and one-half feet deep and has a current of about one mile per hour. Another branch comes in from the south but had stopped running. However, water was plentiful in deep holes, but alkaline. The land is not liable to be flooded. There are no water-powers. The climate was warm with a fair amount of rain and some high winds. No frosts were noticed. No fuel, stone quarries or minerals were found. The only game seen was antelope.—*W. G. McFarlane, D.L.S., 1908.*

10. The soil in this township is rather more gravelly and sandy and will not make as good farm land as that east of it. The north part will make fair farm land. The surface is gently rolling bare prairie. There is no timber and no hay. There is very little water in this township, but a little can be found in the early part of the summer in holes in an old, small creek bed at the north side of it. The water is good but not plentiful and not likely permanent. There are no water-powers. The climate was warm with some rain and high winds. No frosts were noticed. There is no fuel, stone quarries or minerals. The only game seen was antelope and jack-rabbits.—*W. G. McFarlane, D.L.S., 1908.*

Range 13.

5. (East outline.) The soil of this township is mostly light clay or sandy loam with clay subsoil, suitable for farming or grazing. The surface is slightly rolling bare prairie. There is no timber but there are a few small hay meadows of little account. The water is scarce and partly alkaline. There are no streams of any importance, although a few little creeks were crossed, which are drying up. There are no water-powers, and the land is not liable to be flooded. The weather was warm and showery in June. No fuel, stone quarries or minerals were seen. Antelope were fairly numerous.—*W. G. McFarlane, D.L.S., 1908.*

6. (East outline.) The soil is a sandy loam with clay subsoil and is rather stony in places, but would make fair farming or grazing land. The surface here is also bare prairie, but is much more broken by coulées than that to the south and would be rather rough for good farm land. There is no timber and very little hay. Water is alkaline in small streams and very scarce. The land is not liable to be flooded and there are no water-powers. The weather was warm, with occasional rains. No frosts were noticed. There is no fuel, stone quarries or minerals, and the only game seen was antelope.—*W. G. McFarlane, D.L.S., 1908.*

7. The township is reached by a wagon trail from Swift Current to Pearce's ranch from which there are several trails or tracks running southerly; any one of these leads near to this township. The soil is a brown loam of varying depth underlaid by a sandy clay which is often stony and always very hard. The surface is prairie, very hilly at

Range 13—Continued.

the north but smoother towards the south and west, where the land is somewhat lower; the ridges and hills are mostly stony especially in the northern and eastern parts where it is very rough. There were many small sloughs and a lake in section 19, from which plenty of fresh water may be obtained, but the lake is somewhat alkaline. The nearest available fuel is lignite or brown coal in township 7, range 16. There are no minerals or stone quarries. Frost appeared in August, forming a thin coating of ice. —*Geo. H. Watt, D.L.S., 1908.*

8. The township may be reached by taking the Pelletier lake trail from Swift Current to Pearce's ranch and taking an old trail from there southerly. The soil is good in places but the southern part of the township consists of high hills all of which are stony on the top. There is no timber. Water is found in Notukeu creek which crosses the northwest corner of the township. It is somewhat alkaline and dries up in dry weather. Among the hills at the south there are many sloughs where small quantities of hay may be cut. There are no water-powers, fuel, stone quarries or minerals. Antelope was the only game seen.—*Geo. H. Watt, D.L.S., 1908.*

9. The old Pelletier lake trail crosses range 13 a few miles north of this township and there is an unused trail from it into this township, in section 35. The soil is a brown loam with a sandy subsoil and would grow good crops if there was sufficient moisture. The township is open prairie with a few small trees and bushes along Notukeu creek in section 5. There are no hay sloughs of any size. The water in Notukeu creek is brackish, but that in the creek running in from the north is good. Notukeu creek dried up in the fall. The stream at the time I was there was about six feet wide with but a few inches of water running through; there were many large and deep holes along it which would, I think, contain water in the driest weather. There was a severe frost about August 1, the only one I noticed during the summer. No stone in place, coal, or minerals were found. The land is good but stony on the ridges. —*Geo. H. Watt, D.L.S., 1908.*

Range 14.

7. The township may be reached by taking the Pelletier lake trail from Swift Current to Pearce's ranch and then taking the trail to Hoff's ranch on Frenchman river. Hoff's trail passes along the whole west boundary of this township. The soil is a brown earth overlying sandy or gravelly clay. The grass is mostly good showing good soil. The surface is all prairie, pretty rough in places, and the ridges are mostly stony on the top. There are numerous sloughs of fresh water but there is not much hay around some of them. Many of the sloughs would dry up in a dry summer. The atmosphere is very dry and the township is subject to hot winds in the summer which would, I think, be disastrous to standing grain. There was a severe frost on August 1. There is no fuel in the township but there are coal veins opened twenty-five miles to the west. I saw no minerals of any kind or stone of value. Antelope and duck abound.—*Geo. H. Watt, D.L.S., 1908.*

8. This township can be reached by taking the Pelletier trail from Swift Current to Pearce's ranch and then following the trail to Hoff's ranch which crosses the western part of the township. The soil is a brown peaty loam of varying depth overlying a sandy or gravelly white clay which is very hard. Much of the surface of the township, which is all prairie, is stony, especially on the ridges. Along Notukeu creek there is a considerable area of alkaline soil and barren ground. The water in the creek is alkaline but the sloughs are mostly fresh. There was a sharp frost in

Range 14—Continued.

August, but no others which were noticed this summer. Lignite may be found in the township to the west. There are no stone or minerals of value.—*Geo. H. Watt, D.L.S., 1908.*.

Range 15.

7. This township is on the branch of the old Pelletier lake trail from Swift Current, which leaves the main trail about two miles south of Pelletier lake and crosses Frenchman river at what is known as the 'Fiftymile' crossing. The trail is very little used, as it is very hilly from the south end of the township to Frenchman river. The soil is a brown loam overlying clay, sandy clay or gravel subsoil. Along the river there is considerable alkaline land. The grass for the most part is fair. The hills are stony. The whole surface is prairie and rolling, with no sloughs. There is an alkaline creek about ten links wide, but it dries up altogether in dry weather. The climate is dry and there exist at times dry hot winds. Fuel in the shape of lignite may be obtained about twenty miles west. There are no stone quarries or minerals. Game consists of antelope and duck.—*Geo. H. Watt, D.L.S., 1908.*

8. This township is situated on the branch of the old Pelletier lake trail which runs to the 'Fiftymile' crossing of Frenchman river. The trail was very dim, and as the prairie had been burned bare it was still less noticeable so that it was not noted when chaining. The soil is a brown peaty soil overlying sandy clay or gravel, which is very hard. The ridges, of which there are a great many, are stony and bare on the top. The township is all prairie. There are several small sloughs, but they do not contain much hay. The water in Notukeu creek is alkaline and dries up in the fall in dry seasons, but that in the sloughs is fresh. This part of the country is somewhat dry with hot dry winds occasionally. Hard frosts occurred about August 1, but it was the only one noticed. Fuel in the shape of lignite coal may be obtained about twenty-five miles to the west. There are no stone or minerals. Game consists of antelope and ducks.—*Geo. H. Watt, D.L.S., 1908.*

Range 16.

5. The township is reached by means of the Pelletier lake trail from Swift Current, which, though a well travelled trail, is very hilly in places. The ford on Frenchman river, is a very good one and is called the 'Seventymile' crossing. The only part of the township in which the soil is fit for cultivation is that part lying south of the broken country forming the south side of the river valley and parts of the river flat itself, which are of very rich soil. The remainder of the township is extremely rough and hilly. There are no sloughs in the township, all the water available being that of the river and springs flowing into it. The river is about one chain wide and runs between cut banks about fifteen feet high, which, with the slimy or muddy nature of the bottom, make it unfordable except at long intervals. The river water is good. Along the river, scrub and willow are found and occasionally poplar and other woods. There are no stone or minerals. Game consists of antelope, duck and beaver.—*Geo. H. Watt, D.L.S., 1908.*

7. The best route by which to reach this township is the Pelletier lake trail from Swift Current to about three miles from where the trail leaves the valley below Pelletier lake. From this place there are many dim trails running a short distance in a southwesterly direction and from there it is possible to travel across country almost anywhere. The soil is very poor, being gravelly and stony on the hills and pure gravel or gumbo on the flats. There may be a few good farms but the greater part is very poor, even for grazing. An alkaline creek flows through the eastern portion in

Range 16—Continued.

the early spring, but soon dries up. There was no water in it in June. There is no hay, fuel, water-powers, minerals or stone quarries. A number of antelope were seen.—*Geo. H. Watt, D.L.S., 1908.*

51. The trail from Battleford to Birch lake passes through sections 25 and 35 of this township and forms the best route for reaching it, as it is generally good condition. There are some hills to be crossed but they present no special difficulty. One creek, which has to be crossed might cause trouble in a wet season. The soil in this township consists of a thin layer of black mould with a subsoil generally of clay loam or sandy clay. In many places stones occur but not so thickly as to interfere with agricultural operations. About half of the township has first class soil, the remainder being second class. Practically the whole of the surface is covered with either a light or heavy scrub poplar and willow. A great many small open spaces occur especially in the northwest portion of the township and also near the shores of lake Macleod. About eighteen per cent of the surface is water, ten per cent open, and the remainder scrub poplar and willow, interspersed with scattered poplar and balm of Gilead averaging eight inches in diameter. Sections 2, 3, 4, 5 and 6 are rolling, while the remainder is gently rolling country. Poplar and balm of Gilead averaging about eight inches are scattered all over the township. A small amount of spruce is found near the small lakes in sections 5 and 6. These trees average about eight or nine inches in diameter the largest being about fourteen inches. Altogether about one hundred thousand feet of lumber could be cut. Grass grows luxuriantly in all the open places throughout the township. Scattered over the township are a few very small hay meadows. The upland grass should make good hay. This township is well supplied with water. Birch lake occupies about half of sections 25 and 36 and along the south outline of the township is a string of lakes connected by small creeks. Several sloughs are to be found throughout the township, all of which contain good drinking water. Lake Macleod, a rather shallow lake of 2,000 acres area occupies parts of sections 10, 11, 14, 15, 16, 22 and 23. The water is slightly brackish. The supply is sufficient and permanent. No land is liable to be flooded to any serious extent. The small streams along the south outline average about eight feet wide and six inches deep with an average current of three miles an hour. No water-power could be generated. The climate was cool, the days being moderately warm, considerable rain was experienced. No summer frosts occurred. Fuel in the shape of poplar can readily be procured throughout the township. No coal or lignite veins were seen. No stone in place was observed, although loose stones for building purposes are abundant. No minerals of economic value were found. Game seemed to be rather scarce, as the Indians have for a long time made this district their hunting ground. An occasional prairie-chicken or partridge was seen, while ducks of various kinds were very plentiful. Trails of red deer and moose were noticed. Rabbits and other small game did not appear to exist. Elk (Wapiti) had evidently lived here formerly but no recent traces of them were noticed. Birch lake and the series of small lakes mentioned contain an enormous quantity of fish, those noticed being jackfish (pike), whitefish, sucker and pickerel (doré.)—*H. S. Holcroft, D.L.S., 1907.*

Range 17.

5. This township is situated on the trail from East End to Wood mountain and may be reached by taking the trail running south from Gull Lake station on the Canadian Pacific railway to the intersection of the above mentioned trail and then following along the latter to the township. They are both good trails. The surface is prairie, except some brush along Frenchman river serving only as fuel. In the southeastern part of the township and in the western and northern portions the sur-

Range 17—Continued.

face is very rough, just a succession of coulées and breaks, making it totally unfit for cultivation. There are no hay meadows. The water in Frenchman river is good. A few springs rise in the northern portion but like the majority of the springs in this portion of the country, they do not run far before they are absorbed by the atmosphere and the parched nature of the ground. The climate is exceedingly dry, making agricultural pursuits hazardous. I saw no stone quarries, or minerals. A few antelope were seen and many traces of beaver in the river.—*Geo. H. Watt, D.L.S., 1908.*

7. This township lies between the trails running south from Gull Lake station on the Canadian Pacific railway and Swift Current. Probably the latter trail is the nearer. If the Pelletier lake trail is followed southerly to a point about three miles south of the lake a fairly level road may be had across country to this township. The soil is suitable for raising grain but in many places is underlaid by hard clay or gravel. The surface is entirely prairie, there being no timber or scrub of any kind found on it. There are no extensive hay sloughs. The water found in the sloughs is good. There is no fuel in the township but there is every evidence of coal in the township south of this one. There are no stone quarries or minerals. A herd of about twenty antelope was seen several times.—*Geo. H. Watt, D.L.S., 1908.*

Range 18.

5. The best road to this township is the East End trail from Gull Lake station on the Canadian Pacific railway as far as East End and mountain trail and then the latter eastward till the township is reached. It is a well travelled road all the way. Where the surface is not broken by coulées the soil is very good, being principally a sandy loam with very little fine sand and is suitable for the growth of grain or root crops. In the coulées the surface is usually bare clay or gravelly. There is a small quantity of poplar and willow in the coulées running up into sections 5 and 6 and it is the only fuel known. There are no hay marshes, water-powers, stone quarries or minerals. The water in the sloughs, which are not numerous, is good. Game consists of duck and antelope.—*Geo. H. Watt, D.L.S., 1908.*

6. The township is best reached by taking the trail from Gull Lake station on the Canadian Pacific railway to East End as far as the north boundary of township 8 and then striking southeasterly across country till the township is reached. The surface of the township is very rough and broken by at least two large coulées which with the coulées running into them and the amount of country lying in them almost unfits the township for farming. It is a good grazing country, there being plenty of good water in the sloughs and in Mule creek which is a spring creek and does not dry up. There are a few clumps of trees in sheltered places in the coulées. In all the coulées there is evidence of coal, probably lignite. In former years beds of coal have been burned, as is evidenced by the baked clays with their brilliant colours which attract the eye from long distances. There were some beds of sandstone outcropping in one place, but I could not say whether they were the edge of an extensive bed or were but the remains of one of the huge boulders that are occasionally met with. There is little or no hay and no water-powers nor minerals. Antelope were plentiful.—*Geo. H. Watt, D.L.S., 1908.*

7. The township is most easily reached by taking the East End trail from Gull Lake station on the Canadian Pacific railway to the north boundary of township 8, from where the best route to follow is across country till the township is reached. The soil is generally a sandy loam or clay with clay subsoil but in places the clay has been washed away leaving the surface stony or gravelly. The surface is rolling but broken

Range 18—Continued.

by coulées, some of them well defined. There are a number of sloughs especially in the southwestern portion, some of which are deep while others to a limited extent grow some hay. The water in the sloughs is good. Fuel in the shape of lignite may be had in section 16 of the township to the west. There are no water-powers, fuel, stone quarries or minerals. Antelope and duck abound.—*Geo. H. Watt, D.L.S., 1908.*

Range 19.

5. The trail from Gull Lake station on the Canadian Pacific railway to East End intersects the trail from East End to Wood mountain a few miles west of this township and the latter trail crosses the township in a northwesterly direction, the two trails thus forming an excellent road to town. The greater portion of the township is broken by the valley of Frenchman river, and a system of ravines which break up the northwestern part of the township, while the remainder is somewhat rough and stony. There are a few clumps of poplar and willow in sheltered, moist spots in the coulées There are no hay meadows, water-powers, stone quarries or minerals of economic value. Game is scarce. A few beavers were working on the river and occasionally an antelope was seen south of the river. In the coulées there were a number of springs of water, some fresh, some alkaline and some strongly impregnated with hydrogen sulphide. These springs did not give out enough water to form a stream large enough to reach the river, but after running for less than a mile they gradually dwindled and eventually dried up altogether. There are a few small sloughs, which with the springs and the river, furnish plenty of water.—*Geo. H. Watt, D.L.S., 1908.*

6. This township is reached by taking the trail from Gull Lake station on the Canadian Pacific railway to East End and following it to about the north boundary of township 8, a little beyond which the trail branches, the one leading east running as far as the coal mines which are located in section 16, township 7, range 19. From here the township is easily reached across country. The surface of this township is undulating or rolling. The middle and northerly portions support good thick grass but some of the remainder of the township is stony. The whole, however, with the exception of a few small coulées and stony ridges might be cultivated with good results. There are no hay sloughs, timber of any kind, stone quarries, water-powers or minerals. Fuel in the shape of lignite coal may be had in the township to the north. On the southern part there are no sloughs, but deep one are found in the northeast part of the township. No game was seen.—*Geo. H. Watt, D.L.S., 1908.*

7. The trail running northwesterly from the coal mine in section 16 joins the East End-Gull lake trail in about ten or twelve miles and this is the best road between the township and the railway. The south half and the eastern one-third of the township are the most suitable for farming but the northwestern portion is broken by a few coulées and a large alkaline desert. There is no wood or brush found, the whole being bare prairie, There are no hay meadows, but a few sloughs occur with good water. The small creek crossing section 20 dries up in the summer. It is a branch of Rock creek. There are no stone quarries, or water-powers. In a coulée in section 16 a seam of coal is exposed and from the appearance of the trail from it I would presume that quite a number of persons come there for fuel. There are no doubt several seams but the uppermost one, which is the one mined, is about four feet thick. I am told that it makes good fuel for threshing engines, but the sample I got would not burn except with a very strong draft.—*Geo. H. Watt, D.L.S., 1908.*

TOWNSHIPS WEST OF THE THIRD MERIDIAN.

Range 20.

4. This township is most conveniently reached by a trail from Gull Lake station on the Canadian Pacific railway, which crosses Frenchman river in section 6, township 5, enters this township in section 34 and goes in a southeasterly direction into Montana. It is a good hard trail, the only difficulty met with being in crossing Swiftcurrent and Frenchman rivers. It is necessary to divide a load to make these fords and to get out of the valleys. The whole township is open, gently rolling prairie, mostly of a clay loam with a clay subsoil, although considerable has been classed as gumbo. The latter really seems to be a dark clay which has become very hard owing to the lack of moisture. Considerable gravel is found mixed with the clay in many places in the township. While the soil and surface would warrant the tilling of the soil the climatic conditions would suggest ranching or possibly mixed farming as the more profitable. The rainfall is light. Most of the sloughs were dry and growing good hay. What water was obtainable from a few sloughs was very good but these I believe would be dry by August or September. There was no indication of coal or other minerals and the only fuel available is lignite in township 7, range 19 or wood from the Cypress hills to the northwest, about twenty-five miles. No building stone appears. Antelope were plentiful and quite a few duck were seen.—*J. Waldron, D.L.S., 1908.*

5. This township is most conveniently reached by a trail from Gull Lake station on the Canadian Pacific railway. It is a good smooth road at all seasons of the year the only difficulty being the crossing of Swiftcurrent creek and the settlers expect to have this bridged in the very near future. With the exception of the valley of Frenchman river, which flows in a southeasterly direction from the northwest corner of the township leaving it in section 24, the surface is quite smooth. The soil south of the valley is mostly a gravelly clay with a few inches of clay loam on the surface. It is good pasture land and is mostly suited for ranching. The river valley has a lighter soil nearly free of gravel or stone and could be made very productive by irrigation. Frenchman river, the only water on the surface, does not contain any waterpowers but has sufficient fall to make it useful for irrigation purposes. Quite a few beaver have their dwellings in the small willow scrub along its banks, and the deep pools afford good fishing, the principal fish being gold-eye. We experienced no frosts, but the season was very dry. Scrub poplar and willow in very limited quantities grow in the coulées leading into Frenchman river and is the only fuel supply nearer than the Cypress hills. There are some indications of coal of very poor variety of lignite. The seams crop out along the river banks but are not thick enough to be of much use. No other minerals occur. Beaver, ducks and antelope were seen.—*J. Waldron, D.L.S., 1908.*

6. This township is most conveniently reached by a good, hard, smooth trail from Gull Lake station on the Canadian Pacific railway which enters it in section 32. This trail is in good condition at all seasons of the year. The whole township is open prairie, the east side being nearly level and of a deep loam covered with abundance of hay and grass. The central and western part is slightly more rolling but as productive as the east. The southwesterly part becomes more broken as it approaches Frenchman river, the slopes of which are rough and stony. Sections 7, 5, 4 and 3 are too rough for agricultural purposes. Most of section 6 is in the river valley and is of a sandy loam which would be very productive, if irrigated. Frenchman river, the only source of surface water in the township, with the exception of a few sloughs which dry up in the early part of the summer, is about seventy links wide with a current of three miles an hour. It has no falls or water-powers, but by dams, could be made useful for irrigation. It is soft in the bottom and dangerous to cross with horses except at the gravelly bars which are not numerous. The best crossing we found is in the southeast quarter of section 6. A small quantity of small

Range 20—Continued.

poplar grows on the north slope of the river in sections 8 and 4. Small veins, a few inches thick, of a very poor lignite coal appear along the river slope but do not appear to be of any commercial value. A supply of wood fuel may be obtained in the Cypress hills, township 6, range 21, or good lignite is obtainable about the centre of township 7, range 19. No stone quarries occur but plenty of surface stone suitable for building can be had on the river slope. The weather during the day was all that could be desired but the nights during May were not without frosts. No minerals of economic value appear and the only game seen was antelope, although there were signs of beaver along the river.—*J. Waldron, D.L.S., 1908.*

7. This township is most conveniently reached by a good trail from Gull Lake station on the Canadian Pacific railway, which enters the township in section 34 and passes through it in a southwesterly direction. The surface is open rolling prairie and quite smooth with the exception of parts of sections 9, 10, 4, 3 and 6 which are a little rough. Considerable alkali is met with in the northeast part of the township but with the exception of these alkaline spots the soil is mostly a deep clay loam with a clay subsoil and is very suitable for farming, so much so, that it was eagerly sought for by intending settlers and has now been nearly all taken up. Hay and pasture is abundant everywhere in the township. Large herds of cattle and horses, the property of ranchers along Swiftcurrent creek, were grazing here, and their sleek condition was a living testimony of the splendid quality of the grass. No timber of any kind grows in the township but it may be readily obtained about six miles west, in the Cypress hills. Some evidences of soft coal appear where badgers had been digging in the southeast part, but no veins appear on the surface. Plenty of fuel can be obtained from a lignite vein of very good quality in about the centre of township 7, range 19. The only surface water, with the exception of some small sloughs which have the appearance of being dry most of the summer, is in lake Lawrence in section 35, and a small stream of fresh water which rises in section 4 and passes through sections 5 and 6. Lawrence lake is a shallow fresh water lake on the south shore of which there is some good building sand. No streams with any water-powers occur. At the beginning of May the days were beautiful and bright, but frosts occurred on some of the nights. No stone quarries or minerals appear. Quite a few antelope and many coyotes and badgers were seen.—*J. Waldron, D.L.S., 1908.*

Range 21.

5. This township is most conveniently reached by trail either from Maple Creek or Gull Lake station on the Canadian Pacific railway. These trails join in the valley of Frenchman river in township 6, range 21, and thence there is no difficulty in driving directly across the prairie to this township. Gull Lake trail is much the smoother. The whole township is open prairie, no timber of any kind growing in it. The northeast part is hilly and rough while the remainder is rolling prairie, increasing in elevation going westward. The central part is suitable for cultivation while the east and west is better adapted for grazing. The soil is chiefly a clay loam with a clay subsoil. A coulée leading up from Frenchman river through sections 36, 35, 26, 23 and 14 forms a valuable hay meadow. A spring occurs at the upper end of it and has the appearance of giving a good water supply if opened up. A small alkaline slough was found in section 8, and was the only surface water obtainable. A dry creek passes through section 32 and indications point to a large flow of water in wet seasons. Grass was plentiful everywhere and of good quality. No frosts were experienced. Wood in township 7, range 22, is the nearest fuel obtainable. No coal veins or other minerals occur. Surface stone, suitable for building, may be gathered in the east part of the township. Coyotes and kit foxes were the only animals seen.—*J. Waldron, D.L.S., 1908.*

Range 21—Continued.

6. This township is readily reached by a trail from Maple Creek station on the Canadian Pacific railway, which enters the township in section 31, or by a trail from Gull Lake station on the Canadian Pacific railway, which enters the township in sections 25 and 24. The latter is the more direct and smoother road and is good at all seasons of the year. The surface is very much broken by Frenchman river and the many coulées that lead into its valley. This valley, which is from forty to sixty chains wide, comprises the greater part of sections 31, 29, 28, 27, 26, 24, 13 and the easterly half of sections 12 and 1. It is mostly a sandy loam with a sandy clay subsoil and in its original state was covered with sage brush and not very productive. A very extensive and systematic irrigation scheme is just about completed by Messrs. Enright and Strong, more familiarly known as the owners of the z-x (Z bar X) ranch, whereby the valley as far as the centre of section 27 will become, and in the upper part, has become, very productive. Mr. Morrison, who lives in section 24, is developing an irrigation scheme by which he will be able to irrigate the remaining part of the valley in this township and has a splendid chance of being well rewarded for his labours. The slopes leading down to the river bottom are rough and stony. The central part of the south portion of the township is comparatively smooth and suitable for farming. The remainder is more suitable for grazing. A beautiful spring of fresh water rises in section 29, and this with Frenchman river is the only surface water of a permanent nature. No waterfalls or power exists. There is no fuel in the township, but plenty can be obtained in township 7, range 22. No veins of coal or other minerals occur. No game of any kind was seen. Insufficient rainfall seems to be characteristic of this region. No summer frosts were experienced.—*J. Waldron, D.L.S., 1908.*

7. The southerly part of this township is readily reached by a trail from Maple Creek station on the Canadian Pacific railway, which enters the township in section 6, or by a trail from Gull Lake station, which follows the Swift Current creek coulée through the township. Either of these trails is a good hard road. The soil is clay loam with a clay subsoil. Ths surface is broken and in the southwesterly part very hilly. Some small poplar and willow, with an occasional spruce is found among the hills on the west. There are no minerals or stone quarries but plenty of wood may be found for fuel. There are many springs in the hills. The settlers in this township are mostly engaged in stock raising and by irrigating are able to cut abundance of hay.—*J. Waldron, D.L.S., 1908.*

Range 22.

5. This township can readily be reached by trail either from Maple Creek or Gull Lake stations on the main line of the Canadian Pacific railway. They both enter township 6 and from there they merge into the trail up the valley of Frenchman river; it is good travelling across the prairie, after getting on top of the slope to the river, but the road from Gull Lake station is the smoother and is more to be preferred for heavy loads. The soil of this township is a good clay loam, about six inches deep, with a clay subsoil and is well adapted for mixed farming. Plenty of hay can be cut almost anywhere in this township but especially on the edges of the sloughs, of which there are quite a few, and all contain good fresh water. The western part is rough and hilly, especially sections 18 and 19. The remainder of the township is open, rolling prairie, smooth enough for easy cultivation, except sections 36, 35, 24, 13 and 12, through which a broken coulée passes. This contains many fresh springs and affords splendid shelter for cattle. There are no creeks of any kind. The climate was warm and free from frosts. Rainfall seemed more plentiful than in the ranges farther east. This is possibly due to its higher elevation and proximity to the Cypress hills. No

Range 22—Continued.

coal appears, but wood for fuel is plentiful about six miles north. No minerals of economic value occur. Antelope and duck were the only game seen.—*J. Waldron, D.L.S., 1908.*

6. This township is readily reached by trails from Gull Lake or Maple Creek station on the Canadian Pacific railway, both of which enter the northerly end of the township, or by a trail from Chinook, Montana. The trail from Gull Lake station is smoother and better than the Maple Creek trail. The greater part of the township is very rough and broken. Frenchman river crosses the township about the north chord. The valley is from one to two miles wide and has very high rough banks on either side. The high lands north and south of the valley are inclined to be hilly with considerable surface stone. The soil is mostly clay loam with clay subsoil but quite a lot of sand and gravel appear in the proximity of the river. The township is suitable for ranching. The uplands grow good hay while the deep valley affords splendid shelter for stock. Two ranchers have done some irrigation work to make the valley more productive. Frenchman river is about fifty links wide, with a current of about three miles an hour. No falls or water-powers occur. Most of the coulées, on the north slope of the river, contain small poplar and willow, while on the south side a few spruce appear in section 7. There is just sufficient to meet the immediate needs of the settlers. The remainder of the township, with the exception of a little willow along the river, is open prairie. Small veins, a few inches thick, of lignite crop out frequently along the river valley. I was informed that it burns very well and is very suitable for heating purposes. Many good fresh springs rise on the north slope. During June we experienced no frosts and the climate seemed very salubrious. No stone quarries or minerals of economic value were found. Chicken and sage hens were the only fowl seen. No other game was noticed.—*J. Waldron, D.L.S., 1908.*

7. This township can be best reached by a surveyed trail from Maple Creek, a station on the main line of the Canadian Pacific railway. It is hilly but hard most of the way and has good water along it. This trail is known as the mail route from Maple Creek to East End postoffice which is in section 26. This township is in the Cypress hills and is very much broken by coulées, a great many of which are wooded with small poplar and willow and a few spruce. The smoothest part is south of the south chord and is mostly rolling prairie. Many ranchers are settled along the small creeks which contain a plentiful supply of good spring water. Some of them have done a little cultivation with good results. It is essentially a ranching district. The coulées form splendid shelter and grazing grounds for stock. The soil in the hills is mostly sandy or gravelly, while in the more level portions the soil is generally a clay loam with a clay subsoil. Small surface stone are plentiful. Plenty of wood for fuel is found in the coulées and timber suitable for building, but only enough for the immediate needs of settlers. Small veins of coal crop out along the slopes of creeks. It is of a soft variety, but burns very well. No other minerals occur. They have summer frosts in the hills. Splendid hay can be cut on the uplands. No stone quarries were seen. Quite a few timber wolves infest this region and are a source of annoyance to the ranchers. An occasional deer is seen.—*J. Waldron, D.L.S., 1908.*

Range 23.

5. The west side of the southeast part of this township is somewhat hilly while the remainder is mostly rolling prairie. Gravelly clay predominates with a few inches of fertile loam on top. Quite a number of small sloughs are scattered throughout the township and around these hay grows in abundance. Apart from the sloughs there is

Range 23—Continued.

plenty of grass for grazing purposes. It is best suited for ranching or mixed farming. There is a good trail from Maple Creek station, Canadian Pacific railway, into the township north of this and from there travelling across the prairie into this township is good. The sloughs are all fresh and some springs of fresh water appear in the hills in the west part. There is no fuel in the township but wood is plentiful in the Cypress hills, in the township north of this. No minerals of economic value occur. Ducks were plentiful and a few antelope were seen.—*J. Waldron, D.L.S., 1908.*

6. This township is most conveniently reached by a trail from Maple Creek station, Canadian Pacific railway. It is somewhat hilly but is hard and should be in good condition most of the year. On the uplands above Frenchman river, which flows through the township about the north chord, the soil is mostly a clay loam with a clay subsoil. In the river valley it is mostly a sandy loam with a sandy clay subsoil, but gumbo, gravel and stony clay is often met with. The uplands produce good hay with sufficient rainfall and are suitable for farming or ranching. In the river valley the soil is productive where irrigation has been resorted to. The numerous coulées leading into the river valley are partly wooded with small poplar and willow with an occasional spruce and the open spaces form splendid grazing grounds and shelter for cattle. The north end of the township is in the Cypress hills and is very rough and hilly. The only surface water is in Frenchman river, and a small spring creek from the Cypress hills in section 19. The climate is free from summer frosts but was very dry; small seams of a poor lignite coal appear along the river, but they do not appear to be of any economic value. No other minerals or quarries occur, but surface stone is plentiful for building purposes. With the exception of a few ducks and an occasional deer, game is very scarce.—*J. Waldron, D.L.S., 1908.*

Range 26.

1. This township is readily reached by trail from Maple Creek, a station on the main line of the Canadian Pacific railway. There is also a good trail from Montana on the south. The surface is undulating to rolling prairie. The soil is sandy or light clay and best suited for ranching. The general indications point to comparatively little rainfall in the summer months. There are no large hay meadows but hay grows well over most of the township for so little rainfall. There were no summer frosts. The only water supply was Battle creek and it was not running in August. There are no possible water-powers on the creek. The banks vary from fifteen to thirty feet. There is no timber or fuel of any kind in the township. A fairly good burning coal may be obtained in the township west of this. The nearest timber is in the Cypress hills, near Tenmile. There are no stone quarries, but there is plenty of surface stone. There are no minerals in this township. A few antelopes were seen.—*J. Waldron, D.L.S., 1908.*

2. This township is open and for the most part gently rolling prairie. There is none that can be called hilly. The soil is variable. In the vicinity of Battle creek, which passes through the west half of the township, it is mostly a sandy loam. Away from the river, clay loam with clay subsoil predominates. Gumbo is frequently met with. Quite a few surface stone are scattered throughout the township. Battle creek could be dammed and some of the adjoining lands made productive by irrigation. The remainder is essentially a grazing district. The rainfall does not appear to be sufficient for agriculture alone. Because of the dry season the grass was short, but of good quality. There is no fuel of any kind in this township. The nearest supply is a soft coal in township 1, range 27, or wood from the Cypress

hills about forty-five miles to the northwest. No minerals of economic value occur. The only stone available for building is the ordinary field stone. A few antelope were seen. The township can readily be reached by a good trail from Maple creek, a station on the Canadian Pacific railway.—*J. Waldron, D.L.S., 1908.*

3. This township is best reached by a trail which runs south from Maple Creek station past the east end of Cypress lake and enters the township in section 32. This is a splendid trail and suitable for heavy loads. The soil is chiefly clay loam with a clay subsoil, and is suitable for farming or ranching. The surface is undulating and is all open prairie. Hay is plentiful, but water is scarce, being found only in small sloughs early in the season. The country was very dry but judging from what information could be obtained from ranchers and from existing water courses, it was an exceptionally dry season. The climate is free from summer frosts and with sufficient rainfall the township would produce grain and vegetables, and would be very suitable for grazing. No minerals, waterfalls or quarries exist. Game is very scarce.—*J. Waldron, D.L.S., 1908.*

4. A good hard trail from Maple Creek station, Canadian Pacific railway, enters this township in section 33 and passes south through the township and on to Havre, Montana. Many springs cross it between Cypress lake and Maple creek, affording a plentiful supply of fresh water at convenient intervals. Nearly the whole township is level, open prairie, the only exception being a little broken land along the river in sections 17 and 18. The soil is mostly gumbo in the easterly part, clay in the centre, and a more sandy soil along Battle creek. The gumbo was very hard after the little covering of vegetable loam was removed. In the gumbo area the grass was short and thin, but improved as we got nearer the river. While it is short and thin, ranchers in sections 31 and 20 claimed it to be better for cattle and horses than the longer and coarser grass which grows in such abundance in the Cypress hills. Large herds of horses were brought from the hills to graze in this township. No hay meadows occur. Irrigation has been carried on quite extensively along Battle creek, and with a plentiful supply of water the ground becomes very productive. Battle creek is a small stream with low banks. The water coming from the Cypress hills is pure and sparkling. It was quite low in July owing to the absence of rainfall and to its being used for irrigation purposes at many points before it enters this township. The climate was very warm and dry. The most convenient fuel supply is about thirty miles northwest, in the Cypress hills. No stone quarries or minerals of any economic value occur. Game is very scarce, coyotes being the only animal seen.—*J. Waldron, D.L.S. 1908.*

50. The northern third of this township is a hilly prairie with a few scattered clumps of poplar and willow brush. There are many small lakes and sloughs, some of which are alkaline. The soil is a sandy loam with a clay subsoil. Prairie-chicken, coyotes and muskrats were seen in small numbers. There was no indication of mineral.—*T. A. Davies, D.L.S., 1907.*

51. This township is hilly prairie with a few scattered clumps of second growth poplar and willow brush. The soil is a sandy loam with a clay subsoil. Small lakes and sloughs are numerous, some of which are alkaline. Duck, prairie-chicken, coyotes and muskrats are to be seen. There was no indication of mineral. Two trails lead into the township from Lloydminster. There was one English settler located in section 28, owning a few head of cattle. He had apparently been in the country for a short time, as improvements on his quarter section were limited to about fifteen acres of ploughed land, besides his house, and a shelter for the cattle.—*T. A. Davies, D.L.S., 1907.*

Range 26—Continued.

52. This township is hilly prairie with a few scattered clumps of second-growth poplar and willow brush. The soil is a sandy loam with a clay subsoil and is first class in the quarter sections adjoining lake No. 11. Sloughs and lakes are numerous, a few of them being alkaline. Two trails lead into the township from Lloydminster. Duck, prairie-chicken, coyotes and muskrats were seen. There were no indication of minerals.—*T. A. Davies, D.L.S., 1907.*

53. Saskatchewan river flows through this township from southwest to northeast, dividing it almost equally. The northern part is again divided by the valley of Pipestone creek, a stream of pure water from one to three feet deep, and eight feet wide, flowing approximately two and one-half miles per hour. The country to the west of Pipestone creek is rough and broken with small lakes, sloughs and marshes which are mostly alkaline. Spruce, tamarack and poplar, two to ten inches, and willow bush grow in large clumps. That part to the east of Pipestone creek is rolling, with clumps of poplar and willow bush. There are a few small sloughs and marshes. The soil to the north of the Saskatchewan is a sandy loam with sand subsoil. Good wild hay grows abundantly. To the south of the Saskatchewan the country is hilly and broken with clumps of poplar and willow bush. The sloughs and lakes are not so often alkaline as in the northern part. The soil is a sandy loam with a clay subsoil. There was plenty of good wild hay. Wheat and oats were grown in small quantities. Game consists of duck, prairie-chicken, coyotes and a few deer. There were no indications of minerals.—*T. A. Davies, D.L.S., 1907.*

Range 27.

1. This township is most conveniently reached by a trail from Maple Creek station, on the Canadian Pacific railway, from the north or by trail from Havre to the south. The soil varies greatly from sandy loam with sand subsoil to clay loam with clay subsoil. In fact sandy, gravelly, clay and gumbo soil often appear in the same section. There are also quite a few field stones. It is all open rolling prairie suitable for grazing rather than farming. The grass is of a good quality and very plentiful considering the scarcity of rainfall. Woodpile coulée in sections 8 and 5 furnishes the only available surface water and this is dry late in the season. There is an outcropping of coal in this coulée and it has been mined for local use by the ranchers. The seam is exposed for about one hundred feet and is about thirty inches thick. It is of a rather poor lignite variety but burns very well with a little wood. This is the only fuel in the township. Surface stone suitable for building is plentiful but no quarries or other minerals of economic value occur. Antelope are quite plentiful and are the only animals met with. During August the climate was very dry and warm. —*J. Waldron, D.L.S., 1908.*

2. This township is most conveniently reached by a trail from Maple Creek, a station on the Canadian Pacific railway. It is a good hard trail but is somewhat hilly. It enters the township in section 32 and passes nearly due south through it into Montana. Settlers from the south can most conveniently reach the township by this trail. The surface is open, gently rolling prairie, no timber of any kind being found in the township. The soil, is mostly a clay loam with a clay subsoil. In some places it is inclined to be gravelly and stony. Many small dry sloughs occur and also many dry water courses which indicate more rainfall during some seasons. It was very dry this season but everything indicated that this was an unusually dry year. No frosts appeared. Because of the uncertainity of the rainfall it is essentially a ranching country and the many dry sloughs produce plenty of hay. Battle creek which

Range 27—Continued.

passes through the northeast corner of the township was a series of disconnected pools. The nearest fuel obtainable is in township 1, range 27, where a soft coal may be had that burns very well. There is no timber nearer than the Cypress hills. No minerals or stone quarries occur. A few antelope were seen.—*W. G. McFarlane, D.L.S., 1908.*

3. This township is most conveniently reached by a trail from Maple Creek station, Canadian Pacific railway, which enters the township in section 33 and continues nearly due south. This is a splendid trail, being hard and having water at frequent intervals. The surface is open, undulating prairie. The soil is mostly a clay loam with a clay subsoil, with small stone frequently intermingled, except in the river valley, where it is more sandy. Burnt spots frequently occur and are quite unproductive. The township is best suited for ranching, as it has the appearance of being too dry for cultivation. Ranchers in sections 33 and 3 have done some irrigation work and are being well rewarded for their labours. Battle creek flows south through the centre of the township, and is the only water attainable on the surface. It had almost stopped running, but I was informed that it was eight years since it had been so low. The grass was short, but of a good quality, as the appearance of the many cattle feeding testified. The nearest fuel is in the Cypress hills about thirty-five miles to the northwest. No frosts occurred during the survey (July). There were no indications of any minerals or stone quarries. A few antelope and duck were seen.—*J. Waldron, D.L.S., 1908.*

4. This township is most easily reached by a very good trail from Maple Creek, a station on the main line of the Canadian Pacific railway. The surface is mostly gently rolling prairie, becoming slightly hilly in the southwest part of the township. The soil is mostly a clay loam with a clay subsoil, but gumbo and gravelly clay frequently occur. The season was very dry and the hay short. Battle creek, which passes through the northeast and southeast corners, was very low and was the only water obtainable. It was being used farther up stream for irrigation purposes. Dry watercourses occur, which indicate a greater rainfall than occurred this season. The grass is very nutritious, and the township is most suitable for grazing. The soil is suitable for farming, but during dry seasons, such as this one, it would not be very productive. There is no fuel of any kind, but plenty of wood may be obtained in the Cypress hills, about thirty miles to the northwest. No stone quarries or minerals exist on the surface. A few antelope were seen.—*J. Waldron, D.L.S., 1908.*

Range 30.

2. This township is best reached by a trail from Maple Creek station, which passes through Tenmile, and goes on south through township 2, range 29, to a customs port of entry and Mounted Police station on the international boundary. This trail is hilly but hard, with water at convenient intervals. The surface is open, level or gently rolling prairie, with quite a few surface stone, especially in the northern portion of the township. The soil is chiefly a clay loam with a clay subsoil, and, owing to the dryness of the climate, is chiefly adapted to ranching, the grass being of a very nutritious variety. Lodge creek passes through the northeast corner of the township. It is a small stream, and at the time of the survey (August) it had stopped running, but a plentiful supply of water was found in the pools. Judging from the many dry water courses, which are cut several feet deep in many instances, the country is subject to heavy rainfalls at long intervals rather than to frequent gentle showers. No water-powers exist. The climate was free from frosts and very dry. The only timber available is in the Cypress hills, about twenty-five miles to the north. A large butte in Montana, just below the international boundary and a little east of range

TOWNSHIPS WEST OF THE THIRD MERIDIAN.

Range 30—Continued.

30, furnishes a splendid variety of coal for domestic use. No stone quarries or minerals occur in the township. Numerous antelope were seen.—*J. Waldron, D.L.S., 1908.*

3. The most convenient route to reach this township is a trail from Maple creek, a station on the main line of the Canadian Pacific railway, south, past Tenmile. This trail goes through range 29 and travelling is good across the prairie from it to this township. The south two-thirds of the township is nearly level except where broken by Lodge creek. The northerly part is higher and more rolling. The soil of the level part is mostly a light coloured clay with not much loam on top. The surface is rough to drive over because of the many holes caused by the loam being burnt. The soil improves in the more elevated part in the north and is here quite productive of good grass and hay. The grass is very short in the low part between the hills and the creek. Cactus is very plentiful. Large herds of cattle were grazing here which would account for the grass being short near the creek as it is the only water supply. It had stopped running in August and was a series of disconnected pools. There is every evidence of a big flow in the spring and the presence of driftwood on the slopes indicates that the whole valley is sometimes flooded. There are no waterfalls or water-powers. There were no frosts but there did not appear to be sufficient rainfall for the cultivation of crops. The nearest fuel is wood in the Cypress hills or coal from a hill in Montana just a little south of the international boundary. No minerals occur and the only stone available is surface stone. No game of any kind was seen.—*J. Waldron, D.L.S., 1908.*

TOWNSHIPS WEST OF THE FOURTH MERIDIAN.

Range 1.

59. The best road to this township is from Kitscoty or Vermilion on the Canadian Northern railway by way of Frog lake and Cold lake wagon road, which passes near this township. The soil consists of from two to twenty inches of loam with clay subsoil. Here and there is a layer of sand under the loam near old creek beds. The surface is covered with the usual aspen or poplar, and scattered birch and jackpine with spruce and tamarack in small quantities in the swamps. There is a little hay land near the shores of some lakes and creeks. The water is all fresh and pure. There are a number of small lakes and creeks in the township giving a plentiful supply of water. The land is not liable to be flooded. The climate is delightful and salubrious, and summer frosts are rare. There is an abundance of wood for fuel. Coal or lignite has not yet been discovered, neither stone quarries nor other valuable minerals. Deer, moose, foxes, mink, rabbits, bear, muskrats and coyetes are plentiful.—*M. W. Hopkins, D.L.S., 1907.*

60. The best way to reach this township is from Kitscoty or Vermilion on the Canadian Northern railway by way of Frog lake and Cold lake wagon road which passes near the township. The soil is composed of from two to six inches loam with clay subsoil and suitable for general farming. The surface is covered with the usual aspen or poplar with scattered jackpine and in low and swampy places a little spruce. There are some small hay marshes around a few sloughs. The water is all fresh. There are a number of small lakes and a large creek running around the southwest and the north parts of the township. There are no water-powers and the land is not liable to be flooded. The climate is delightful and salubrious and summer frosts are

Range 1—Continued.

rare. There is plenty of wood for fuel. No coal nor lignite have yet been discovered, neither stone quarries nor other valuable minerals. Deer, moose, mink, muskrats, rabbits, foxes and coyotes are numerous.—*M. W. Hopkins, D.L.S., 1907.*

Range 2.

1. The surface of the township as a whole is undulating prairie. The nearest railway station is Medicine Hat, about one hundred miles by trail to the north. The soil as a whole is third class, being a gravelly loam or gumbo, except along the south boundary where the drying up by ditches and extreme drought of the extensive bed of Wildhorse lake has left a small area of land which is used as hay meadow and could be profitably cultivated. The township in the main however, is adapted to horse ranching which is largely carried on at present, some ranches having as much as thirty miles in pasture. There is no timber of any description in the township, the settlers having to procure their wood for building, fencing, &c., from the Eagle hills, about thirty miles to the north. Hay grows, as remarked above, in the low land surrounding Wildhorse lake on the south boundary of the township and also, I believe, in a few shallow meadows throughout the township, but owing to the extremely hot winds of this year, no hay was put up, not even around Wildhorse lake. During the past summer drinkable water was obtained only in an occasional well or spring, and also in a few pot-holes in the creeks during the first part of the season, but this was of a strong alkaline or soda nature. The water in the lakes and creeks is of such a muddy consistency that only animals can drink it. I kept one team for the purpose of drawing water which had to be brought from five to seven miles. I am told however, that in some years the supply of water in Sage creek which passes through the township and also in Wildhorse and Milk River lakes, is ample and good, particularly after a few years of heavy snowfall and rains. There are no water-powers. The climate is hot with dry winds during the months of June, July and August and the temperature averages from 90° to 100° Fahrenheit. There were no summer frosts during the survey (July). The residents procure their firewood from Eagle hills, thirty miles north, but I am told that there is an undeveloped seam of lignite about the eastern boundary which has been tried, but with indifferent results. Outcroppings of a loose sandstone appear in places along Sage creek, but it does not appear to have been used or developed. No minerals were seen or heard of. Bands of antelope were occasionally seen, also a few sage fowl and ducks were noticed.—*A. Driscoll, D.L.S., 1908.*

2. This township was reached by a good wagon road from Medicine Hat, about ninety miles to the north. The soil is a sandy, gravelly loam with occasional gumbo and is suitable mainly for grazing. The surface is slightly rolling prairie destitute of any timber. No hay had been cut this year but in wet years hay can be secured by cutting the prairie grass. Sage creek entering at the northwest corner of the township and flowing southeasterly had alkaline water in pools only (in July), but in ordinary years I am told it contains an abundance of water. A small creek at the northeast corner of the township also had water in pools. There are no water-powers in the township. The climate is dry, with no indications of early frosts. Fuel is brought from Eagle hills, about thirty miles north, where spruce timber is abundant. No lignite, coal, stone quarries or minerals were seen or heard of. Game, in the shape of antelope and jack-rabbits is fairly plentiful, but no other kind of game was seen.—*A. Driscoll, D.L.S., 1908.*

3. (North and east outlines.) The country crossed by this line is reached by a good wagon road from Medicine Hat, the nearest railway town, to the north, distant about seventy-five miles. The soil is of a gravelly or gumbo nature, suitable only for

Range 2—Continued.

grazing purposes. The surface is an undulating to rolling prairie, destitute of timber of any kind. Hay is scarce at any time owing to the dry nature of the country. Good water was found in pools in Bare creek at the northeast corner of this township and of a muddy consistency in Sage creek, about twelve miles west. There were no water-powers. The climate at any time is dry, but during the past season was exceedingly so during the summer months. No frosts occurred. Fuel is found in the Eagle hills to the north, about twenty miles distant, but no lignite, coal, stone or minerals were found. Game, in the shape of antelope was plentiful; also a few ducks were seen.—*A. Driscoll, D.L.S., 1908.*

4. This township is reached by a good wagon road from Medicine Hat, the nearest railway town, about eighty miles to the north. The soil is a sandy gravel with occasional gumbo and suitable for grazing purposes. The surface is rolling prairie with no timber of any description. Hay is obtained only by cutting the prairie grass. Water can be found only at the northeast and southwest corners of the township, where Lodge and Willow creeks are located. The water of these creeks is of good quality but no water-powers exist. The climate is dry, with no indication of summer frosts. Fuel is brought from Eagle hills where spruce timber abounds, but no lignite or coal is found, neither stone quarries or minerals. Antelope is plentiful and a few prairie-chicken and ducks were seen.—*A. Driscoll, D.L.S., 1908.*

5. This township is reached by good trails or wagon roads from Medicine Hat, the nearest railway station, about seventy-five miles north. The soil as a whole is a gravelly loam suitable only for grazing purposes, but in the valley of Lodge creek where there are springs for irrigation purposes and where the soil is somewhat better, good sized areas are brought under hay fields. The surface is a rough prairie destitute of timber of any description. A small quantity of hay is grown on irrigated lands and a certain amount is cut on the open prairie during wet years. Water of a good quality can be had from Lodge creek which runs diagonally through the township from the northwest corner. This creek is about twenty-five feet wide between banks, and when full would have a rapid current; it was very low, however, at the time of the survey (June). The climate is dry, with no sign of frost during the months of June, July, August and September. Fuel in the shape of timber can be had from Eagle hills, about fifteen miles to the north. Lignite or coal is not in evidence, neither stone quarries nor minerals. Game in the shape of antelope is plentiful and a few duck and prairie-chicken were seen.—*A. Driscoll, D.L.S., 1908.*

59. The best way to reach this township is from Vermilion or Kitscoty on the Canadian Northern railway by way of Frog lake and Cold lake wagon road, which is in very good condition. The soil consists of from two to three inches of rich loam with a clay subsoil. In parts of the township there is a layer of sandy soil between the loam and clay. The soil is suitable for general farming. The township is chiefly covered with the usual aspen or so-called poplar with some beech, and scattered spruce in the swampy ground. No valuable timber is found. There are a number of small lakes and Thompson lake, four miles long and one mile wide, on the north boundary of the township in sections 32, 33, 34 and 35. The water is all pure, fresh and permanent. There are no water-powers and the land is not liable to be flooded. The climate is fine and summer frosts are rare. There is plenty of wood for fuel, but coal or lignite has not yet been discovered, neither stone quarries, nor other valuable minerals. Fish, deer, moose, foxes, mink, bear, rabbits and coyotes are plentiful. —*M. W. Hopkins, D.L.S., 1907.*

60. This township can be easily reached from Kitscoty or Vermilion on the Canadian Northern railway by way of Frog lake and Cold lake wagon road which

Range 2—Continued.

runs across it. The soil consists of from two to eight inches of loam with good clay subsoil suitable for general farming. The surface is covered with the usual aspen or poplar with scattered spruce and a few birch. There is not much hay marsh. There is an abundance of good fresh water, all of which is pure. Thompson lake on the south boundary is four miles long and one mile wide. There are no water-powers and the land is not liable to be flooded. The climate is delightful and salubrious. There is plenty of wood for fuel. Coal or lignite has not yet been discovered in this township. No stone quarries or other valuable minerals were noticed. Deer, moose, mink, muskrat, foxes, rabbits, bear and coyotes are plentiful. —*M. W. Hopkins, D.L.S., 1907.*

Range 3.

1. From Medicine Hat, the nearest railway station, about one hundred miles north there are good trails or wagon roads. The soil is a gravelly loam and gumbo, which grows a nutritious grass favourable for range cattle and horses, but it is too dry and hard for agriculture. The surface of the country is undulating to hilly in the south. No timber of any description was found. Hay is very scarce and none was put up during last summer. Shallow meadows are to be seen which no doubt in wet years yield abundance of hay, but during the past year these meadows were hardly discernible. Water for drinking purposes was only to be had from the wells sunk by the ranchers, but the western end of Milk River lake barely crosses the eastern boundary of this township and the stock come through to drink. Both the lake and the wells are strongly impregnated with alkali. There are no water-powers. The climate is hot with dry winds which seem to preclude summer frosts. Fuel in the shape of spruce timber can be had from Eagle hills, about thirty-five miles to the northeast. No coal or lignite was seen or heard of. Stone in the shape of loose sandstone appears in the southern portion of this township, but it is doubtful whether it could be developed sufficiently for commercial purposes. No minerals were seen or heard of. Game in the shape of antelope is plentiful but that was the only kind seen.—*A. Driscoll, D.L.S., 1908.*

2. This township is reached by a good wagon road from Medicine Hat, the nearest railway station, about seventy-five miles north. The surface is a rolling prairie suitable for grazing, and the soil is a sandy gravel loam with occasional gumbo. No timber of any description is to be found in this township. Sage creek, crossing the northeast corner of this township, contains some pools fed by springs which supply good water. No other water was found. In wet years Sage creek contains an ample supply of water during the whole season. The climate is dry, as evidenced by the small growth of grass, and no hay was put up this year. Summer frosts were not experienced. Fuel is to be had from the Eagle hills in the shape of spruce timber, about twenty-five miles distant. No lignite or coal was seen, neither any stone quarries or minerals. Game in the shape of antelope is plentiful, also a few sage fowl were noticed.—*A. Driscoll, D.L.S., 1908.*

3. (North and east outlines.) The country crossed by this line is reached by a good wagon road from Medicine Hat, the nearest railway town to the north, distant about seventy-five miles. The soil is of a gravelly or gumbo nature suitable only for grazing purposes. The surface is an undulating to rolling prairie destitute of timber of any kind. Hay is scarce at any time owing to the dry nature of the country. Good water was found in pools in Bare creek at the northeast corner of township 3, range 2, and of a muddy consistency in Sage creek, about twelve miles west. There were no water-powers. The climate at any time is dry but during the past season was

Range 3—Continued.

exceedingly so during the summer months. No frosts occurred. Fuel is found in the Eagle hills to the north, about twenty miles distant, but no liguite, coal, stone or minerals were found. Game in the shape of antelope was plentiful; also a few ducks were seen.—*A. Driscoll, D.L.S., 1908.*

4. This township is reached by a good wagon road from Medicine Hat, the nearest railway station, about eighty miles north. The soil is a sandy gravel loam with occasional gumbo. The surface is a rolling prairie suitable only for grazing. There is no timber in the township nor hay land. Bare creek, flowing diagonally through the township from northwest to southeast, affords good water, though only in pools at the time of the survey (June). There are no water-powers. The climate is dry, as evidenced by the vegetation, and there were no signs of summer frosts. Fuel can be obtained in the shape of spruce timber from the Eagle hills, about twenty miles to the north. No coal or lignite was heard of, neither stone quarries nor minerals. Antelope were plentiful and a few prairie-chicken and ducks were seen.—*A. Driscoll, D.L.S., 1908.*

5. This township was reached by a good wagon road from Medicine Hat, the nearest railway station, about seventy-five miles north. The soil is a sandy loam, mixed with gravel in places, also spots of gumbo. It is well adapted for stock raising. The surface is rolling prairie destitute of timber of any description. The drouth this year apparently prevented the ranchers from putting up any hay. Bare creek flows diagonally through the township southeasterly, and also Willow creek, flowing through sections 25, 35 and 36 affords this township a good supply of pure water; both creeks were, at the time of survey (June), very low, but I understand that as a rule they contain a large supply of running water, but without anything in the shape of water-powers on them. The climate is dry, as evidenced by the vegetation, and no summer frosts were experienced. Wood is obtained from the Eagle hills about fifteen miles north, but no coal or lignite is found in the vicinity. Stone quarries or minerals were not seen or heard of. Game in the shape of antelope is plentiful, also a few ducks and prairie-chicken.—*A. Driscoll, D.L.S., 1908.*

59. The best way to reach this township is from Kitscoty or Vermilion on the Canadian Northern railway, by way of Frog lake and Cold lake wagon road, which is good all the way and passes right through the township. The soil consists of from two to six inches of rich loam with a good clay subsoil and is suitable for general farming. The surface is covered with the usual aspen trees, with a few birch and scattered spruce around the lakes and swampy places. There is not much hay marsh. There are a number of small lakes and two large ones, Reita lake in the northwest part, five miles long by three broad, and Cushing lake extending into the southwest part in sections 5 and 6. The water is all pure, fresh and permanent. There are no water-powers and the land is not liable to be flooded. The climate is delightful and summer frosts are rare. There has been no coal or lignite discovered yet, neither stone quarries nor other valuable minerals. Fish, deer, moose, foxes, mink, bears, rabbits and coyotes are plentiful.—*M. W. Hopkins, D.L.S., 1907.*

60. The best way to reach this township is from Vermilion or Kitscoty on the Canadian Northern railway, by a good road that passes through it from Frog lake to Cold lake. The soil is a rich loam two to four inches deep, with clay subsoil, suitable for general farming. The surface is covered with poplar or aspen trees, making good fuel, and there is sufficient spruce for buildings for settlers. No valuable timber occurs in sufficient quantity for commerce. There are small patches of natural hay

Range 3—Continued.

growing around the sloughs. There is an abundance of permanent good fresh water. All the water in this section of the country is good and fresh. There are numerous small creeks and small lakes, with three large lakes in, or partly in, the township. The land is not liable to be flooded. There are no water-powers. The climate is mild and good and summer frosts are not usual. There is plenty of wood for fuel but no coal or lignite beds were exposed. No stone quarries were discovered nor any valuable minerals. There is an abundance of fish in the lakes and an occasional deer, moose or bear roaming around. Many fur-bearing animals as foxes, mink and coyotes are found. —*M. W. Hopkins, D.L.S., 1907.*

Range 4.

1. This township is reached by a good trail from Medicine Hat, the nearest railway town, about one hundred miles to the north. The soil is a gravelly loam and gumbo, suitable only for producing grass for grazing purposes. The surface of the country is prairie, entirely destitute of timber with the exception of a few cottonwood trees growing in the valley of Milk river, situated at the southwest corner of this township. With this exception timber for fuel is brought from Eagle hills, about thirty-five miles to the northeast. No coal or lignite was seen. Hay this year was very scarce, none having been put up, as the meadows were all dry. Water of good quality is to be had from Milk river, which touches the south boundary of this township in section 6, and also from springs at the northwest and southeast corners of the township. Lost river, which runs diagonally through this township in a southeasterly direction. contains a small quantity of water in shallow pools, but it is not fit for drinking purposes except by cattle. There are no water-powers. The climate during the summer season is very dry and hot, with no signs of summer frosts. Fuel is had from Eagle hills, some thirty-five miles to the northeast, and lignite and coal is not in evidence, neither stone quarries or minerals. Game in the shape of antelope is fairly plentiful.—*A. Driscoll, D.L.S., 1908.*

2. This township is reached by a good trail from Medicine Hat, the nearest railway station, about ninety miles north. The soil is a gravelly loam and gumbo, which grows good range grass, but is too hard and dry for agriculture. The surface is gently rolling prairie, and is destitute of timber of any description. Hay during wet years, no doubt, is to be had, but anything in the shape of meadow is at present dried up. Water was only had this year in a spring at the southwest corner of the township; all creeks were dry and there were no water-powers. The climate is exceedingly dry, with hot winds throughout the months of July, August and September, and there were no indications of frosts during those months. Fuel, in the shape of spruce timber, is to be had at Eagle hills, about twenty-five miles to the northeast; no indications of coal or lignite were seen, nor any stone or minerals. Game, in the shape of antelope, was fairly plentiful, but no other kind was seen.—*A. Driscoll, D.L.S., 1908.*

3. (East outline.) The country crossed by this line is reached by a good wagon road from Medicine Hat, the nearest railway town to the north, distant about seventy-five miles. The soil is of a gravelly or gumbo nature, suitable only for grazing purposes. The surface is an undulating to rolling prairie, destitute of timber of any kind. Hay is scarce at any time owing to the dry nature of the country. Good water was found in pools in Bare creek at the northeast corner of township 3, range 2, and of a muddy consistency in Sage creek, about twelve miles west. There were no water-powers. The climate at any time is dry, but the past season was exceedingly so during the summer months. No frosts occurred. Fuel is found in the Eagle hills to the

Range 4—Continued.

north, about twenty miles distant, but no lignite, coal, stone or minerals were found. Game, in the shape of antelope, was plentiful; also a few ducks were seen.—*A. Driscoll, D.L.S., 1908.*

4. A good wagon trail leads from Medicine Hat to Archer's ranch, situated in section 26 of this township. There is another trail by way of Eagle Butte postoffice, but while this is in good condition from Medicine Hat to Eagle Butte, it is rough and not well marked from Eagle Butte to Archer's. The prevailing kind of soil is a light coating of sandy loam with gumbo subsoil. In the bad lands, of which there is considerable in this township, the soil is mostly gumbo, on which there is little vegetation exeept a species of vine cedar, which in places grows quite thickly. The soil is not good for agriculture unless irrigated, though along Sage creek some vegetables and a little grain have been grown. This township is most suitable for grazing, the grass, especially in the northeastern part, being quite thick but brown and dry, though stock seem to thrive well on it. There is great lack of water. There is no spring in the township, nor any sloughs containing any quantity of water, and Sage creek is small and dries up during the summer. At Archer's ranch good cold water was obtained by digging. The surfaee is rolling prairie with some very deep ravines, the northwestern part being almost entirely bad lands. The general slope from both eastern and western boundaries is towards the centre, veering towards the southeast as the southern boundary is approached. There is no timber. The sloughs and creeks are alkaline. Good water can be obtained by digging near Sage creek. There is not sufficient for water-power or irrigation, nor is there any danger of flooding. The climate is very dry during the greater part of the summer, though during the latter part of May and the early part of June there is generally abundance of rain. Hot, scorching winds prevail during the summer. The air is very clear and bright. Summer frosts are not common, and cold winds from the north are prevented a great deal by the Cypress hills. Fuel is very scarce. Wood can be obtained only at the Cypress hills, about twenty-five miles distant. There are no stone quarries, but coal can be obtained in the adjoining township. There are two outcroppings of very poor quality showing in the western part of the township. There are a few antelope and numerous coyotes, gophers and jack-rabbits. A few sloughs are found which, in general, do not supply the ranchers with sufficient hay. A slough is cut about once in three years. In dry years hay is very scarce.—*A. G. Stacey, D.L.S., 1908.*

5. A good wagon trail leads directly from Medicine Hat to McLean's ranch in section 21 of this township. Another trail leads from Medicine Hat to Eagle Butte and thence to McLean's, but the latter is rough and not clearly defined besides being a good many miles longer. The soil is mostly a sandy loam with gumbo subsoil. The northwestern portion is mostly bad lands. The eastern and northeastern part of this township would be suitable for agriculture if it were irrigated but it is too dry in its present state to grow grain. The grass is quite good here, but brown and dry, though stock seem to thrive well on it. The surface is mostly rolling prairie with a slope from eastern and western boundaries towards the basin of Sage creek. There are some very large ravines. Sage creek rises in the bad lands in the northwestern part of the township. There is no timber, but there are a few good sloughs in the northeastern part of the township which generally provide sufficient hay for the ranchers though in dry seasons hay is very scarce. Lack of good water is a great drawback to this township. The sloughs do not contain water during the summer and Sage creek dries up. Water can be obtained by digging near Sage creek. There is not sufficient for water-power or irrigation nor is there any danger from flooding. The climate is very dry with scorching winds during the summer. As a general rule there

Range 4—Continued.

is a season of very wet weather during the latter part of May and the early part of June. There are no summer frosts. Wood cannot be obtained nearer than the Cypress hills twenty-five miles distant and this I believe has been lately made a reserve. Fuel can be obtained in the adjoining township. There are no stone quarries nor minerals. There are some antelope, numerous coyotes, gophers and jack-rabbits. —*A. G. Stacey, D.L.S., 1908.*

59. The best way to reach this township is from Kitscoty or Vermilion on the Canadian Northern railway by Frog lake and Cold lake wagon road. This is a good road and passes a couple of miles to the east. There are newer trails from there to this township. The soil is composed of two or three inches rich loam and a clay subsoil. In parts of the township there are layers of sand under the loam where there formerly have been beds of creeks or lakes. The east and south quarter sections of the township are covered with the usual aspen trees with birch, scattered spruce and tamarack in the swamps, while the northwest quarter contains some very valuable spruce and tamarack timber. Very little natural hay meadow is found. There are a few small lakes and Reita lake, five miles long by three wide, extends into the east side of the township. All water is pure, fresh, good and permanent. There are no large streams nor water-powers and the land is not liable to be flooded. The climate is excellent and summer frosts are rare. There is plenty of wood for fuel but no coal nor lignite has been discovered, neither stone quarries nor other valuable minerals. Fish, deer, moose, foxes, rabbits, mink, bear and coyotes are plentiful.—*M. W. Hopkins, D.L.S., 1907.*

60. The best way to reach this township is from Kitscoty or Vermilion on the Canadian Northern railway by Frog lake and Cold lake wagon road which passes four or five miles to the east of the township, from which there is a trail passing into the township. This wagon road is very good. The soil consists of from two to eight inches of rich loam overlaying a clay subsoil, and is suitable for general farming. The surface is covered with the usual aspen or poplar with a few birch and scattered spruce. However, in sections 5, 6 and 7 there is very valuable large spruce timber. Very little hay marsh occurs. There are many little lakes containing pure, fresh water of permanent supply. The cheapest fuel is wood of which there is an abundant supply. No coal or lignite is known to exist. No stone quarries nor other valuable minerals have yet been discovered. Deer, moose, foxes, muskrats, mink, bears, rabbits and coyotes are plentiful.—*M. W. Hopkins, D.L.S., 1907.*

Range 5.

3. (East outline.) The country crossed by this line is reached by a good wagon road from Medicine Hat, the nearest railway town, to the north, distant about seventy-five miles. The soil is of a gravelly or gumbo nature, suitable only for grazing purposes. The surface is an undulating to rolling prairie destitute of timber of any kind. Hay is scarce at any time owing to the dry nature of the country. Good water was found in pools in Bare creek at the northeast corner of township 3, range 2, and of a muddy consistency in Sage creek, about twelve miles west. There were no water-powers. The climate at any time is dry, but during the past season was exceedingly so during the summer months. No frosts occurred. Fuel is found in the Eagle hills to the north, about twenty miles distant, but no lignite, coal, stone or minerals were found. Game in the shape of antelope was plentiful; also a few ducks were seen.—*A. Driscoll, D.L.S., 1908.*

Range 5—Continued.

4. A good wagon road leads directly from Medicine Hat to the south part of township 5, range 5; from there a branch road leads through the centre of this township to Penland's ranch on Ketchum creek in section 11. The soil in the western half of this township is sandy loam with gumbo subsoil, and if irrigated it would be suitable for agriculture. The eastern portion is mostly bad lands at the southern part, becoming largely a gumbo flat. The grazing in the western part is good, but in the remainder grass is very scarce. The surface is gently rolling. One mile south of the north boundary is a height of land sloping north to the south branch of Manyberries creek and south to Ketchum creek. The northeastern part is bad lands, and the southeastern part is gumbo flat. There is no timber and there is very little hay. In a wet season some can be cut in the western half of the township. There are no large sloughs, consequently the supply is limited and the quality is quite inferior. Ketchum creek passes through this township. It is not a running stream during the summer, but keeps enough water in pools to supply the needs of stock. The water is quite alkaline. There is no danger of flooding. There is not sufficient water to develop any kind of water-power, but Mr. Penland is having dams constructed to retain the surplus of freshet water for watering stock in summer. The climate is as a rule very hot and dry, with high, scorching winds. There is abundance of rainfall during the latter part of May and the early part of June. The winter is very cold, and stock suffer severely for want of shelter. There are no summer frosts. Wood can be obtained only at the Cypress hills, thirty-five miles distant. Coal can be obtained in this township in the northeastern part, though the quality at the present depth is not good, and coal is mostly brought from a mine in township 3, range 3. There are no stone quarries, but there is some coal. Some antelope and numerous coyotes, gophers and jack-rabbits were seen.—*A. G. Stacey, D.L.S., 1908.*

5. A good wagon road leads from Medicine Hat to McLaren's ranch in section 21, township 5, range 4, and thence in a southwesterly direction to the southern sections of this township. The soil in the northern and eastern part of this township is almost entirely bad lands, with very little vegetation. The western sections are more loamy with gumbo subsoil and much broken by watercourses. It is not suitable for agriculture unless irrigated and even then the gumbo in the soil holds the water on the surface, preventing it from getting to the roots of vegetation. The soil is more suitable for grazing than anything else, but the grass in this township is very poor. The surface is mostly gently rolling prairie, but in the northern part it is rough and hilly with large ravines and a large extent of bad lands. There is no hay to be obtained in this township and no timber. There are two branches of Manyberries creek in this township. The north branch enters the northwest corner of the township and the south branch crosses the south boundary. The water in the north branch is good, and remains in pools in the river nearby all the year round, but the south branch contains very little water and dries up during the summer. There is not sufficient water for water-power or irrigation nor is there any danger from flooding. The climate is very hot and dry, with scorching winds. As a general rule there is plenty of rain during the latter part of May and the early part of June, but very dry during the rest of the year. The winter is cold, with high winds from which there is little protection. Snow does not fall to a great depth. There are no summer frosts. Wood can be obtained only at the Cypress hills about thirty miles distant. Coal of inferior quality can be obtained in the adjoining township. There are no stone quarries nor minerals. Some antelope, coyotes, gophers and jack-rabbits were seen.—*A. G. Stacey, D.L.S., 1908.*

59. This township can be reached from Vermilion, on the Canadian Northern railway, by the ferry to St. Paul de Metis, thence to the Keheewin Indian reserve, which

adjoins this township. All the roads are good. The soil is from four to seven inches of rich loam with clay subsoil suitable for general farming. The surface is covered with aspen, birch and scattered spruce. The north half of the township is taken up by Muriel lake. There is no valuable timber for commerce except possibly along the east side extending from the valuable timber area in the adjoining township. The only hay areas are in the sloughs, as the township is covered with woods. All the water, of which there is an abundance, is fresh, good and permanent; there are no large streams, but Muriel lake takes up half the township. The land is not liable to be flooded. There are no water-powers in the township. The climate is delightful and summer frosts are not usual. Wood, of which there is a large quantity is the only kind of fuel in the township. No stone or other minerals were exposed. Fish, deer, bear, foxes, muskrats, mink and moose are numerous.—*M. W. Hopkins, D.L.S., 1907.*

60. The most convenient way to reach this township is from Vermilion, on the Canadian Northern railway, by way of St. Paul de Metis and the Keheewin Indian reserve. A good road extends all the way. The soil consists of from two to five inches of rich loam, underlaid by clay. In places there is a layer of sand between the loam and clay, where formerly creeks or other running water has flowed. It is suitable for general farming. The surface is covered with the usual aspen trees with some birch and scattered spruce around swamps. However in section 24 there is some very valuable spruce timber. There is not much hay marsh. Muriel lake takes up the southern half of the township and there are other small lakes. All the water is pure, fresh and permanent. Muriel creek flows out of Muriel lake across sections 23, 25, 36 and 35. There are no water-powers and the land is not liable to be flooded. The climate is charming and summer frosts are rare. The cheapest fuel is wood, which is abundant. No coal nor lignite has been discovered, neither stone quarries nor other valuable minerals. Fish, deer, moose, foxes, mink, muskrats, rabbits and coyotes are plentiful.—*M. W. Hopkins, D.L.S., 1907.*

61. This township can be reached from Vermilion, on the Canadian Northern railway, by the St. Paul de Metis wagon road to Cold lake, which passes through it. The soil consists of from three to eighteen inches of rich loam, with a good clay subsoil, suitable for general farming. The surface is covered by the usual aspen or poplar except in the extensive hay marshes, which extend across the township from section 25 to section 18, and along Muriel creek and the north shore of Charlotte lake. This is very valuable hay land. Being covered with water part of the year, it is continually fertilized and yields a very large quantity of good hay. There is an abundance of good, fresh and pure water. The only land that is liable to be flooded is the hay land above referred to. There are no water-powers in the township. There is an abundance of wood for fuel. Coal or lignite has not yet been discovered, neither stone quarries nor other valuable minerals. Fish abound in large quantities in the two large lakes in the southern part of the township, while deer, moose, bear, mink, rabbits, muskrats and coyotes are plentiful.—*M. W. Hopkins, D.L.S., 1907.*

62. This township can be most conveniently reached by way of St. Paul de Metis from Vermilion, on the Canadian Northern railway. The soil consists of from two to ten inches of rich loam with clay subsoil suitable for general farming. The surface is covered with a growth of aspen, birch and scattered spruce. The aspen is everywhere on the high, dry ground, the birch in damp places, and the spruce in the swamps. There is very little natural hay lands, which are only in the sloughs. There are large quantities of good fresh water in the lakes. Beaver river, which runs across the north

Range 5—Continued.

ern part of the township is from two to three chains wide and over six feet deep in places. All water is good and fresh. The land is not liable to be flooded. There are no very valuable water-powers at present but Beaver river can be dammed up in places so as to be utilized for power. The climate is very delightful and summer frosts are not usual. The only fuel within the limits of the township is wood which is abundant. No stone quarries or other valuable minerals were noticed. Fish are plentiful while deer, moose, foxes, mink, bear and coyotes are numerous.—*M. W. Hopkins, D.L.S., 1907.*

Range 6.

59. There is a good road from Vermilion on the Canadian Northern railway by way of St. Paul de Metis and Kehecwin Indian reserve to this township. The soil consists of about six inches of rich loam with clay subsoil, and is suitable for general farming. The surface is covered with aspen trees with park-like openings in places and is very beautiful, bordering on Jones lake across the north boundary of the township. This lake, however, is alkaline to the taste, but not so much that it cannot be used for drinking. It is the only alkaline lake for many miles around, as all water is pure, fresh and good. There is much hay land around this and other lakes but there is no valuable timber beyond what is required by the settlers. There are no large streams or water-powers and the land is not subject to flooding. The climate is delightful and summer frosts are rare. There is plenty of wood for fuel. No coal or lignite has been found, neither stone quarries nor other valuable minerals. Fish, deer, moose, foxes, rabbits, muskrats, mink and coyotes are plentiful.—*M. W. Hopkins, D.L.S., 1907.*

60. The best route by which to reach this township is from Vermilion on the Canadian Northern railway by the St. Paul de Metis and Cold lake or Moose lake wagon road, which is good all the way. The soil consists of from two to twelve inches of rich loam with a good clay subsoil, suitable for general farming. The surface is covered with the usual aspen or poplar with a few birch and scattered spruce in the swampy places. There is no valuable timber and not much natural hay. There are a number of small fresh water lakes and two large ones. Moose lake in the northwest part is fresh water and Jones lake in the south side of the township is somewhat alkaline, but not enough to make it undrinkable. There are no water-powers and the land is not liable to be flooded. The climate is delightful and salubrious. Summer frosts are rare. There is an abundance of wood for fuel and building purposes, but coal or lignite has not yet been discovered in this township. No stone quarries nor valuable minerals have been found. Deer, moose, fish, foxes, muskrats, rabbits, mink, coyotes and bear are plentiful.—*M. W. Hopkins, D.L.S., 1907.*

61. The best way to reach this township is from Vermilion on the Canadian Northern railway by way of St. Paul de Metis and Cold lake wagon road, which is in good condition all the way. The soil consists of from three to ten inches of rich loam with clay subsoil suitable for general farming. The surface is covered with the usual aspen or poplar, with scrub in places. There is no valuable timber and only a few hay marshes in the east side of the township. The water is all fresh. There are a number of small lakes and two large ones. From the southwest corner of the township Moose lake juts into the centre and Jessie lake extends into the southeast part from range 5. There are no water-powers and the land is not liable to be flooded. There is plenty of wood for fuel but no coal, lignite, stone quarries nor other valuable minerals have been discovered yet. Fish, deer, moose, foxes, mink, bear, muskrats, rabbits and coyotes are plentiful.—*M. W. Hopkins, D.L.S., 1907.*

Range 6—Continued.

62. This township can be most easily reached from Vegreville or Vermilion on the Canadian Northern railway by the St. Paul de Metis and Moose lake wagon road which passes near the township and is a very good road. The soil consists of from two to eighteen inches of rich loam with a good clay subsoil suitable for general farming. The surface is covered by the usual aspen or poplar with scattered spruce in the low ground. There is some hay marsh on the east side of the township. There is an abundance of fresh, pure water. Beaver river runs across the township from section 30 to section 25. It is from two to three chains wide and is about six feet deep in places. It has many little rapids that might be dammed so as to be utilized for power in small quantities. There is an abundance of wood for fuel but no coal nor lignite has yet been discovered in the township. No stone quarries nor other valuable mineral deposits are known to exist. Deer, moose, mink, muskrat, foxes, bear and fish are plentiful.—*M. W. Hopkins, D.L.S., 1907.*

Range 7.

3. This township is reached by a good wagon road from Medicine Hat, the nearest railway town about one hundred miles to the north. The soil is a sandy loam and is adapted to grazing purposes. The surface is an undulating prairie destitute of any timber. Hay is obtained in ordinary years along the shores of Pakowki lake but this season was so dry that none was harvested. Manyberries creek near the northeast corner which had good water in pools supplies drinking water, besides which the only water in the township is in Pakowki lake and it is fit only for animals. There are no water-powers. The climate is dry with no indications of summer frosts. Fuel in the shape of spruce timber can be obtained from Eagle hills, about thirty-five miles to the northeast, and also a small quantity of cottonwood along Milk river about ten miles south. No coal, lignite, minerals or stone quarries were seen. Antelope, duck and jack-rabbits are fairly plentiful.—*A. Driscoll, D.L.S., 1908.*

4. This township is reached by a good wagon road from Medicine Hat, the nearest railway town, about seventy-five miles to the north. The soil varies from sand, sandy loam to clay and gumbo and is particularly adapted to grazing, being in the vicinity of the larger water area, Pakowki lake. The surface of the ground is an undulating prairie with no timber whatever. Hay in ordinary wet years is plentiful along the shores of Pakowki lake, but there was none harvested this year. Water can be had only in Pakowki lake and is fit only for animals. No water-powers are in the township. The climate is dry with no summer frosts. Fuel is had from the spruce timber on Eagle hills about thirty-five miles to the northeast and also from a limited amount along Milk river. Coal, lignite, minerals and stone quarries were not seen. Of game there was antelope, duck and jack-rabbits in fair quantities.—*A. Driscoll, D.L.S., 1908.*

5. This township is reached by a good wagon road from Medicine Hat, the nearest railway town, about ninety miles to the north. The soil is a sandy loam with occasional gumbo and is most suitable for grazing purposes. The surface is an undulating prairie without any timber. Hay in fairly wet years is plentiful along the shores of Pakowki lake, but there was none during the past season on account of the drouth. Water of fair quality was found in pools in Manyberries creek which empties into Pakowki lake. The lake itself, however, is of a strongly alkaline or soda nature and the water is used only for animals. No water-powers were found. The climate, judging by the past season, is dry with no indications of summer frosts. Fuel can be had from Eagle hills to the northeast in the shape of spruce timber and

Range 7—Continued.

also a small quantity of poplar and cottonwood from the valley of Milk river, about twenty miles south. No lignite, coal, stone quarries or minerals were seen. Antelope were fairly plentiful, also ducks and jack-rabbits.—*A. Driscoll, D.L.S., 1908.*

Range 8.

3. This township is reached by a good wagon road from Medicine Hat, the nearest railway town, about one hundred and ten miles north. The soil is a sandy loam adapted for grazing purposes. The surface is a rolling prairie destitute of timber. There was no hay this year. Water fit for animals only, and strongly alkaline or soda, can be had from Pakowki lake in this township. There are no water-powers. The climate is dry with no summer frosts. Spruce timber for fuel is obtained from Eagle hills, about forty miles to the northeast, and also some cottonwood and poplar from Milk river, about ten miles to the south. There are no minerals, coal, lignite or stone quarries. Antelope, duck and jack-rabbits are plentiful.—*A. Driscoll, D.L.S., 1908.*

4. This township is reached by a good wagon road from Medicine Hat, the nearest railway town, about one hundred and ten miles north. The soil is a sandy loam adapted to grazing purposes. The surface is rolling prairie destitute of timber. There was no hay this year. Water fit for animals only, and strongly alkaline or soda, is obtained from Pakowki lake, situated in the northeast portion of the township. No water-powers were noticed. The climate is dry with no summer frosts. Spruce timber for fuel can be had from Eagle hills, about forty miles to the northeast, and also a small amount of cottonwood is found on Milk river, about ten miles to the south. No coal, lignite, minerals, or stone quarries were seen. Antelope, duck, and jack-rabbits were fairly plentiful.—*A. Driscoll, D.L.S., 1908.*

5. This township is reached by a good wagon road from Medicine Hat about one hundred miles to the north. The soil is a sandy loam suitable for grazing purposes. The surface is a rolling prairie destitute of timber. On account of the drouth this season there was no hay. Pakowki lake which takes up the southern half of the township affords the only water available, and that is fit only for animals, as it is strongly alkaline. The climate is dry with no summer frosts. Spruce timber for fuel can be obtained from Eagle hills about thirty miles to the northeast. No coal, lignite, minerals or stone quarries were found. Antelope, duck and jack-rabbits are fairly plentiful.—*A. Driscoll, D.L.S., 1908.*

Range 9.

3. This township is reached by a good wagon road from Medicine Hat, the nearest railway town, about one hundred miles northeast. The soil is a sandy loam suitable for grazing purposes. The surface is a rolling prairie without any timber. Hay in ordinary years is to be had in large quantities along the shores of Pakowki lake but this year on account of the great drouth scarcely any was harvested. With the exception of Pakowki lake there is no water in the township and it is fit only for animals. There are no waterfalls or power. The climate, judging by the vegetation and the past season, is dry, but wet periods are also frequent. No summer frosts were experienced. Fuel can be obtained from Milk river where a small amount of cottonwood and poplar grows, also spruce from Eagle hills about forty miles northeast. No coal, lignite, stone quarries or minerals were seen or heard of. Antelope and ducks were fairly plentiful and a few prairie-chicken and jack-rabbits were seen. —*A. Driscoll, D.L.S., 1908.*

TOWNSHIPS WEST OF THE FOURTH MERIDIAN.

Range 9—Continued.

4. This township is reached by a good wagon road from Medicine Hat, the nearest railway town about one hundred and ten miles north. The soil is a sandy loam suitable for grazing purposes. The surface is a rolling prairie destitute of timber. There was no hay put up this year as the season was too dry. Water fit for animals only is to be had in the township to the east but there is no water in this township. The climate was dry with no summer frosts. Spruce timber for fuel can be had in Eagle hills, about forty-five miles to the northeast. No lignite, coal, minerals or stone quarries were seen. Antelope, duck and jack-rabbits are fairly plentiful.—*A. Driscoll, D.L.S., 1908.*

5. This township is reached by a good wagon road from Medicine Hat, about one hundred miles to the north. The soil is a sandy loam adapted for grazing purposes. The surface is rolling prairie destitute of timber. There was no hay this year as the season was too dry. An arm of Pakowki lake extends from east to west through the township, receiving the water overflow from an irrigation ditch at its western end, keeping the lake shore fairly fresh and drinkable. The lake itself is alkaline. The climate is dry with no summer frosts. Spruce timber can be had for fuel from Eagle hills, about thirty-five miles to the northeast. No coal, lignite, minerals or stone quarries were seen. Antelope, duck and jack-rabbits are fairly plentiful.—*A. Driscoll, D.L.S., 1908.*

Range 13.

63. This township is reached by a wagon trail running northerly from the town of Vegreville, on the Canadian Northern railway. The trail passes through Saddle lake and Whitefish lake settlements continuing northerly through township 63, range 14 to Lac la Biche settlement. This trail from Vegreville to Saddle lake is travelled a great deal and is usually in good condition. From Saddle lake to Whitefish lake it is not so good, especially during wet weather. From Whitefish lake to Lac la Biche, it is usually very bad, there being a number of swampy places and hills of considerable size. The surface soil in this township for the most part is shallow loam, ranging from two to six inches in depth. This loam is mostly of a sandy nature. The subsoil is nearly all of a sandy clay nature, which in some places is quite stony. Besides those sections, in which the subsoil is of a stony nature, this township is fairly well adapted to agricultural purposes. It is however a soil which will be fairly hard to work. There are a number of small muskegs in the township, but there are none of large area. With the exception of sections 1 and parts of 2, 12, 36 and small patches along the north slope of Beaver river, this township is all heavily timbered. These portions of sections 1, 2, 12 and 36, which are more heavily timbered, are of a scrubby nature, consisting of small poplar and balm of Gilead, while the excepted portion along the northern bank of Beaver river, varies from small patches of open prairie to a scrubby growth of poplar. The bulk of the timber in this township is poplar, balm of Gilead and birch. There are also small areas of jackpine, while a scattering of spruce occurs throughout the entire township. The poplar and balm of Gilead range in diameter from two to sixteen inches, the birch ranging from about two to ten inches and in some cases fourteen. The spruce ranges from three to eighteen inches, while in section 24 there is a patch of spruce on Beaver river somewhat larger in size, ranging from six to thirty inches. A good deal of the best of this timber, however, has been cut out as there is a Government sawmill located on this section where lumber is cut for the use of the Indians on the Whitefish Lake Indian reserve. The best of the birch in this township is found in sections 22, 15, 16 and 8. The poplar and balm of Gilead is found throughout the

Range 13—Continued.

entire high lands of this township and form the great bulk of the timber. Small quantities of hay may be cut from the flats on small patches of open country along the north bank of Beaver river. Considerable hay is also cut along the flats of Whitefish creek, which enters this township in section 3, flowing through the southerly portion of sections 4 and 5 into the lake of Bays. Besides these two sources very little hay is to be found in this township. There is, however, a considerable growth of peavine throughout scattered sections of the township. This makes the best of hay, when it can be cut, but owing to the timber nature of the country it will be almost impossible to cut any quantity of it here. This township is well supplied with fresh water, while, owing to the rolling nature of the surface, it is in little danger of being seriously flooded. All the water found in this township is fresh. Beaver river crosses the northerly portion of this township, entering section 30 and flowing through sections 30, 29, 28, 27, 26, 23 and 24. This stream varies in width from seventy-five to one hundred and fifty feet and flows through this township in a very deep valley ranging in width from one-half to one and one-quarter miles. This stream is from one to six feet deep, in some sections being quite shallow and rapid while in others it is deep and stagnant. The average flow of this river throughout this township is not more than one or one and a half miles per hour. Whitefish creek which flows through sections 3, 4 and 5, varies in width from fifty to one hundred feet and is from four to eight feet in depth with no perceptible current. A number of small streams are found throughout different sections of the township, but these are of little or no importance. No water-power is available in this township. The climate appears quite similar to that of the country farther south, but owing to the timbered nature of the country it was noted that the foliage remained green longer in the autumn than in those districts fifty or one hundred miles south. No summer frosts of importance were noted during the past season. Wood is the fuel most readily obtained in this township, and can be had in abundance any place. No coal or lignite veins are known to occur. No stone quarries nor minerals of economic value were located nor are any known to occur in this township. Black bear seem quite numerous throughout this township. Moose are also occasionally found, while along Beaver river jumping deer appear to be quite plentiful. Partridge are quite numerous, but prairie-chicken are very rarely seen.—*W. H. Waddell, D.L.S., 1908.*

64. This township is reached by a trail northerly from the town of Vegreville on the Canadian Northern railway. This trail passes through the settlements at Saddle lake and Whitefish lake, and terminates at lac la Biche. This trail passes through this township in a northerly direction, entering in section 1 and passing out of the township in section 34, from Vegreville to Saddle lake. This trail is in splendid condition throughout almost the entire year. From Saddle lake to Whitefish lake it is good during the dry and winter seasons but is bad in the early spring and summer. From Whitefish lake to lac la Biche it is bad throughout almost the entire year. During the spring, summer and autumn seasons it is badly cut up in numerous soft places, and is also broken by a number of very bad hills. The surface soil is of a black sandy loam nature, varying in depth from three to eight inches. The subsoil is for the most part of a sandy clay nature, and in scattered districts this is quite stony. Throughout the western section of the township there is a considerable number of muskegs, where the soil is of a marshy mucky nature, which in its present condition is unsuitable for anything. The high lands of the township, however, are apparently fairly well adapted to agricultural purposes. There are at the present time three settlers located in this township, but up to the present they have done very little farming. The westerly half

Range 13—Continued.

of this township is heavily timbered throughout; sections 1, 2, 11, 12, 13, 14, 24, 23, 25, 26, 27, 34 and 35 are for the most part timbered, but the bush is partly of a scrubby, second growth nature, while small patches of open country are found throughout. The westerly half of this township is timbered with poplar from four to twelve inches in diameter, balm of Gilead, of about the same size, while the muskegs and low lands are timbered with spruce and tamarack ranging from three to eight inches in diameter. A scattering of spruce is found throughout the higher portions of the township, ranging in size from six to eighteen inches. A small amount of birch is also found from one to eight inches in diameter. The timbered portions of the easterly half of this township consist of poplar and balm of Gilead averaging a great deal smaller in size but ranging from two to ten inches in diameter. There is also considerable willow scrub throughout the lighter timbered portions of the township. Considerable hay is cut on the flats around Duck lake and also around a small lake on section 10. There is also a quantity of hay cut on sections 32 and 33, on the flats of Little Beaver river. There are a number of small sloughs throughout this township where hay might be cut , but there are none of much importance. The hay which does occur, however, is all of good quality. The water of this township is all fresh and good and the supply is sufficient and permanent. Owing to the rolling nature of the country I do not think there is a serious danger from floods. Little Beaver river enters this township at section 31, flowing through sections 31, 32, 33, 28, 15, 14, 11 and 1. This river flows through a valley from fifty to seventy-five feet deep and from one-half to one mile in width the stream itself being from fifty to seventy five feet in width, the upper portion being of a stagnant nature from two to six feet in depth, with very little current, while the southerly portion of this township is of a more shallow nature, being from one to two feet in depth with a current from one to one and one-half miles per hour. A number of small creeks are found throughout the township but no streams except Little Beaver river are of any importance. No water-powers of value are found in this township. General indications point to a climate suitable for agricultural purposes. No summer frosts of any importance are known to have occurred in this township during the past season. Wood is the fuel most readily obtained, and may be found in abundance throughout the entire township. No coal or lignite veins are known to occur. No stone quarries nor minerals of economic value were found. Black bear are quite numerous in this township. A few moose are also found. Partridge appear to be quite plentiful, while prairie-chicken are very scarce.—*W. H. Waddell, D.L.S., 1908.*

Range 14.

27. This township is about sixty miles from Bassano, a station on the main line of the Canadian Pacific railway. A trail in good condition affords access to it. The soil is chiefly clay, suitable for general agricultural purposes, but a good deal of it rates only third class. The surface is rolling prairie without any timber. Bullpound creek traverses the township from section 36 to section 1. It was at one time a creek of considerable volume, but it is now only a chain of pools. The water is not good in many places, varying according to the nature of the adjacent soil. There is very little hay land. Climatic conditions are favourable, with no especial danger of summer frosts. Coal is available in several places within twenty miles. It is likely that coal may be found in this township, as it seems to underlie the adjacent district in several places. There are no stone quarries or minerals of economic value. Duck was the only game seen.—*Geo. Edwards, D.L.S., 1907.*

TOWNSHIPS WEST OF THE FOURTH MERIDIAN.

Range 14—Continued.

28. This township is accessible by trail from Gleichen or Bassano, stations on the main line of the Canadian Pacific railway. The soil is chiefly a very heavy clay or gumbo, unfit for cultivation, and for the most part not producing good grass. The surface is rolling prairie without any timber, except a few bunches of willow and scrub along Bullpound creek. There is very little hay land. The only water, other than a few sloughs, is in Bullpound creek. This was at one time, possibly not over twenty years ago, a stream of considerable volume, taking its rise in Handhills lake. This lake, in some way, became drained off, the level falling about twenty feet. As a consequence there is no longer any flow of water from the lake, and the creek is now merely a chain of pools without any current. The water is in some places good and in other places brackish and muddy, according to the nature of the adjoining soil. The climate is good and no special danger of summer frosts. Coal is available for fuel in the adjoining township west and will likely be found in this township as well. There are no stone quarries or minerals of economic value. A few ducks were seen along the creek but no other game was noticed.—*Geo. Edwards, D.L.S., 1907.*

29. This township can be reached by trail from Gleichen or Bassano. The soil is chiefly heavy clay or gumbo, not producing even good grass and most of it worthless for agricultural purposes. The surface is prairie with no timber. The southeast quarter of the township is intersected with deep coulées, while the remainder is level or slightly rolling. There is very little hay land. Bullpound creek traverses the township from section 32 to section 3. This was at one time a stream of considerable volume, having its source in Handhills lake, but owing to a fall of about twenty feet in the lake level, there is now no flow of water from it, and the creek is merely a chain of pools. The water in these pools is sometimes as deep as three or four feet, and is good in some places; in others, muddy and brackish. Climatic conditions are favourable. There is no especial liability to summer frosts. A seam of coal in a coulée on section 6 affords fuel supply to ranchers in this and the adjoining townships. Indications of coal were noticed at several points. There are no stone quarries or other minerals of economic value. A few ducks and prairie-chicken were the only game seen.—*Geo. Edwards, D.L.S., 1907.*

30. The most convenient route to this township is by a good trail from Gleichen. The soil is chiefly heavy clay and gumbo, very poor for any purpose. The surface is rolling prairie without any timber whatever. There is no hay land. Bullpound creek traverses the township, affording the only water supply. This creek has no current, being simply a chain of pools. The climate is good. Summer frosts are not prevalent. Coal can be obtained in the adjoining township west, and probably in this township also. There are no stone quarries or minerals of economic value. Ducks were seen along the creek but no other game.—*Geo. Edwards, D.L.S., 1907.*

31. This township can be reached by wagon from the town of Stettler, on the Lacombe branch of the Canadian Pacific railway, by way of the Handhills trail, which is a fairly good road during the summer months except in a wet season. There are a few creeks and sloughs not yet bridged that are difficult to cross. The soil is generally sandy loam and clay loam; in some of the flats there is gumbo or stiff clay. The loamy soils are good for agricultural purposes. The surface is prairie with no timber worth mentioning. In a few of the sloughs there are a few small poplar, but they have been nearly all killed by prairie fires. Some of the sloughs are surrounded with small willow. A few small poplar are found around the sloughs but they are too small for building purposes. Considerable hay could be cut in the meadows throughout the township. The supply of water is very limited except in Bullpound lake in

sections 7 and 8, and in a dry season it would likely become very low. The water in the sloughs and in Bullpound lake is fairly good for domestic use. Good water can be obtained by digging. There are no water-powers in the township. The climate is inclined to be dry but subject to extremes of drought and moisture. This season was very wet during the month of June. Last season was the other extreme. There is no wood but lignite coal has been found in the adjoining townships, and will no doubt furnish a supply for settlers in this township. No stone quarries, minerals or mineral bearing rocks were found in the township but there is plenty of field stones. Wild duck and geese are very plentiful around the lakes and ponds. A few prairie-chickens and an occasional antelope were seen. Prairie wolves and small animals are not very plentiful. —*Lewis Bolton, D.L.S., 1908.*

32. This township can be reached by wagon by way of the Handhills trail from the town of Stettler on the Lacombe branch of the Canadian Pacific railway. This trail is fairly good during the summer months except in a wet season. There are a few creeks and sloughs not yet bridged that are difficult to cross. The soil is varied from sandy loam to clay and clay loam and suitable for agricultural purposes. The surface is prairie with a few poplar and willow bluffs surrounding some of the sloughs. The timber is of no account for building purposes and the quantity is very small. The northerly part of the township is very hilly, while the remainder is rolling. There is not much hay; a few small meadows are scattered through the township, but none of any great area. There are a few small lakes and sloughs. The water in the lakes is not fit for domestic use; that in most of the sloughs could be used, but they dry up early in the season. There are a few springs, the water supply being limited. Good water can be obtained by digging. No water-powers nor streams of any kind are found. The climate is inclined to be dry but subject to extremes of drought and moisture. No summer frosts occurred this season. There is very little wood. Lignite coal has been found in the adjoining townships and no doubt a sufficient supply can be obtained for the use of settlers in this township. Game is not plentiful except wild geese and duck on the lakes and sloughs; a few antelope and coyotes were seen among the hills. There are no minerals, mineral bearing rocks nor stone quarries, but plenty of field stone is found. This township is well adapted for grazing, the pasture being excellent among the hills but it is rather rough for grain growing.—*Lewis Bolton, D.L.S., 1908.*

63. This township is reached by a trail running northerly from the town of Vegreville, on the Canadian Pacific railway, to the settlement at lac la Biche. This trail is followed to a point about four miles northerly from the settlement at Whitefish lake, where a branch trail westerly is taken, which passes through the southerly portion of this township. From section 10 in this township, a new trail was cut northerly through the township, which is passable during the drier season of the year. The trail from Vegreville, northerly to Saddle lake is well used and in good condition throughout almost the entire year. From Saddle lake to Whitefish lake this trail is very bad during the wet season. The branch trail leading into this township is fairly good during the dry season. The surface soil of this township is from one to twelve inches in depth, part being of clay loam nature and part of a sandy loam nature. The subsoil is of a clay nature throughout almost the entire township, the exceptions being a few sandy ridges, where both the soil and subsoil is of a sandy, useless nature and also contains a number of muskegs throughout the township, where the soil is of a mossy mucky nature and of no value. The upland portion of this township is apparently fairly well suited to agricultural purposes for the most part rating as second class. This township is wooded throughout with timber, ranging in size from two to eighteen inches. A very large percentage of the timber is poplar and

Range 14—Continued.

balm of Gilead, from three to fourteen inches in diameter. Scattered birch is found from two to ten inches in diameter, while scattered spruce is found throughout the entire township, ranging in size from three to fifteen inches in diameter. Ridges of jackpine from six to twelve inches in diameter are found more particularly through the northwesterly quarter of the township. The muskegs and swampy inner lands of the township are timbered with a scrubby growth of spruce and tamarack from two to eight inches in diameter. A considerable area of this latter growth is found in a large muskeg running easterly through sections 20, 21, 22 and 23. Quite a large quantity of good hay has been cut for a number of years from the low flats to the easterly end of Lonepine lake, and also around the shore of a smaller lake in sections 3 and 4. There is also a large quantity of hay of good quality on the low flats to the east of the lake, located in sections 7 and 18. Considerable hay is to be found in flats along Beaver river but not to such an extent as that around the three lakes. A number of small hay sloughs are scattered throughout the township, but none of large size. All the water in this township appears to be fresh and the supply is sufficient and permanent. The hay flats of the township, are all flooded during the early part of the year, but apart from this the land in this township is not liable to be flooded to any extent, owing to the rolling nature of the country. Two streams of considerable size occurred in this township, Whitefish creek, flowing westerly through the southerly portion of the township, and Beaver river, flowing easterly through the northerly portion. Whitefish creek is a stream varying in width from forty to two hundred feet. It enters the township in section 12, flows through sections 12, 11, 10 and part of 9 into Lonepine lake leaving it in section 8, through this section and sections 7 and 18, into another small lake. This stream varies in depth from one to six feet, the greater part being of a very stagnant nature, with a barely perceptible current. Beaver river enters this township at the northwest corner of section 19 and flows easterly through sections 19, 20, 21, 22, 27, 26 and 25. The valley of this river is from seventy-five to one hundred and fifty feet deep, and averages about half a mile in width, the river itself being from seventy-five to one hundred and twenty-five feet wide and averaging from two and one-half to eight feet deep. The current is small, averaging probably not more than one mile per hour. A number of smaller streams, of little or no importance are met with in other parts of the township, the largest of these being a stream flowing out of a small lake in sections 32 and 33 in an easterly direction through sections 34, 35, 26 and 25 and flowing into Beaver river, near the easterly boundary of this township. No water-power is available in this township. The climate is apparently suitable for agricultural purposes. No summer frosts of any consequence are known to have occurred during the past season. Wood is the fuel most readily obtained in this township, and is available in abundance in every section. No coal or lignite veins, and no stone quarries nor minerals of economic value are known to occur in this township. Black bear, moose and caribou are plentiful in this township. Partridge are plentiful but prairie-chicken are not found here at all.—*W. H. Waddell, D.L.S., 1908.*

64. This township is reached by way of the main wagon trail from the town of Vegreville, on the Canadian Northern railway to lac la Biche and a branch trail leading from the former trail about four miles northerly from the settlement at Whitefish lake. This latter trail, taking a westerly course, runs to Lonepine lake in township 63, thence into a new trail northerly, through the centre of township 63, and this township. The main trail from Vegreville to lac la Biche is in splendid condition most of the year as far north as Saddle lake. From Saddle lake to Whitefish lake, it is in very bad shape during the wet season of the year. The branch trail to Lonepine lake and thence northerly, is fairly good during the dry season of the year. The crossing

Range 14—Continued.

of Beaver river in township 63, is very bad. The surface soil of this township is a loam of from two to eight inches in depth, which for the most part is classed as being of a sandy nature. The subsoil is of a sandy, clay nature throughout almost the entire township. A number of small muskegs occur throughout the township in which the soil is of a mossy, mucky nature and is comparatively useless in its present state. While this township cleared, might be rather hard to work owing to the shallow nature of the surface soil, I think it would be fairly well suited to agricultural purposes. This township is of a rolling nature and is heavily timbered throughout. With the exception of a heavy belt of spruce, a great percentage of the timber is composed of poplar and balm of Gilead from three to fourteen inches in diameter. There is a scattering of birch from two to six inches in diameter and also scattered spruce throughout almost the whole township, this latter being from four to fourteen inches in diameter. The muskegs and swampy land are timbered with scrub, spruce and tamarack from four to eight inches in diameter. The heavy spruce belt referred to above is composed of parts of sections 23, 26, 27, 28, 29, 32, 33, 34 and 35. About ninety per cent of the timber in this belt is very heavy spruce of first quality, ranging in diameter from fourteen to forty inches. There is also a scattering of balsam and balm of Gilead of about the same size. Very little hay was found in this township, there being only a small number of sloughs from which hay might be cut. Some might be cut from along the shore of Sherring lake, but this is doubtful, except in very dry seasons. All the water in this township is fresh, and the supply is sufficient and permanent. Little Beaver river enters this township in section 35 and flows in an easterly direction through sections 35 and 36. This river is from fifty to one hundred feet wide in this township and is from two to six feet deep, the current being barely perceptible. No other streams of importance flow through this township. There are four lakes of considerable size, in the southeasterly portion of the township, these being Desmaw, Olympic, Sherring and Kerr lakes. Owing to the rolling nature of the township, I do not think there is much danger from spring floods. No water-powers are to be found in this township. General indications point to a climate suitable to agricultural purposes. No summer frosts are known to have occurred during the past season. Wood is the fuel most readily available in this township, and can be found in abundance on every section. No coal or lignite veins are known to occur in the township. No stone quarries nor minerals of economic value have been found in this township. Moose and bear are plentiful, while caribou, I believe, are also found here. Partridge are plentiful, but prairie-chicken are unknown.—*W. H. Waddell, D.L.S., 1908.*

65. The best route for reaching this township is by way of the main trail from the town of Vegreville, via the Canadian Northern railway to lac la Biche, as far as a point about eight miles south of lac la Biche, in township 65, range 13, where a branch trail turns westerly and crosses through this township in an easterly and westerly direction near the centre of the township. It may also be reached by way of another trail, leaving the main trail four miles north of Whitefish Lake postoffice, thence in a westerly direction to Lonepine lake, thence northerly up the centre of range 15. Both these branch trails are in fair condition during the dry season of the year, but I judge would be impassable from the time of the spring break-up until August. The main trail from Vegreville is in splendid condition throughout almost the entire year. From Saddle lake to Whitefish lake, it is bad during the wet season. From Whitefish lake northerly it is bad at any season of the year. The surface soil in this township is a loam from two to twelve inches in depth, with a sandy clay subsoil with the exception, however, of the muskegs where the soil is of a mossy nature. The greater part of the soil is classed as second class. Some of the best, however, I have rated as first class. I think the greater part is specially adapted to agricultural pur-

Range 14—Continued.

poses. The most of this township is timbered. In the easterly part, however, the timber is much thinner and of a more scrubby nature than in the westerly portions. Small patches of open country occur throughout the easterly half, but these are of little consequence. A very large percentage of the timber of this township is poplar and balm of Gilead from two to twelve inches in diameter. A large portion of the north and westerly part of the township has been burnt over a number of times. Part of this brulé timber has been blown down, but most of it is standing, though dead. In sections 3, 4, 5, 9, 10 and 14 there is a considerable amount of jackpine from four to twelve inches in diameter. The muskegs and swampy parts of the township are timbered with a scrub growth of spruce and tamarack from two to six inches in diameter. A number of these muskegs have been burnt over during recent years in the southerly portion of sections 4 and 5. There is a small area of very heavy spruce and balm of Gilead, the spruce composing fully ninety-five per cent of the timber, and is from twelve to forty inches in diameter. Large quantities of good hay have been cut along the flats of Little Beaver river through sections 26, 23, 22, 15 and 10. A number of smaller patches of good hay land occur throughout the township, but with the exception of Little Beaver flats no hay meadows of much consequence were located in this township. The water in this township is all fresh, and the supply sufficient and permanent. Little Beaver river enters this township in section 36, and flows in a southwesterly direction through this section and sections 25, 26, 23, 15 and 10, then turning in a southeasterly direction through sections 3 and 2. This drain is from fifty to seventy-five feet in width and from one to five feet in depth. The greater part of this river is of a stagnant nature, there being scarcely any flow whatever. There is a rapid, however, near the south side of section 10. A number of small streams flow into the Little Beaver in this township, one in section 10 from the west, two in section 23, one from the southeast and one from the northwest, being small but of a permanent nature, the flats along Beaver river varying in width from one or two hundred feet to half a mile and subject to early floods, as are a number of smaller low lying areas throughout the township, but I do not think that the land, which is suitable to agricultural purposes, is liable to be troubled with floods owing to the rolling nature of the country. No water-power is available in this township. General indications point to a climate suitable to agricultural purposes. No summer frosts are known to have occurred during the past season. Wood is the fuel most readily available here, and can be procured in abundance in any part of the township. No coal or lignite veins are known to occur. No stone quarries of any kind nor minerals of economic value are known to occur in the township. Moose are fairly plentiful, and I believe there are also a number of caribou to be found. Partridge are plentiful and there are also a few prairie-chickens.—*W. H. Waddell, D.L.S., 1908.*

Range 15.

27. This township can be reached by a good trail from Bassano, a station on the main line of the Canadian Pacific railway. The soil is chiefly clay, producing fairly good grass and mostly all suitable for general agricultural purposes. The surface is rolling prairie without any timber. There is not much hay land. There are no streams or springs, the only available water being a few small sloughs. Climatic conditions are favourable, and there is no special danger of summer frosts as far as could be noticed. Coal is obtainable at several points within fifteen miles. There are no stone quarries or minerals of economic value. A few ducks were seen, but no other game.—*Geo. Edwards, D.L.S., 1907.*

Range 15—Continued.

28. The most convenient route to this township is by trail from Gleichen or Bassano, stations on the main line of the Canadian Pacific railway. Both trails are in fairly good condition; that from Bassano is less hilly than the other. The soil is about one-half gumbo and the balance heavy clay, not very desirable for agricultural purposes, but fairly good ranch land. The surface is rolling prairie with no timber. There are no streams. The only water is in a few small lakes and sloughs most of which is alkaline. There are no hay lands of any considerable extent. Climatic conditions are very good, with no special danger from summer frosts. Indications of coal were noticed but none has been mined nearer than township 29, range 14. No stone quarries or minerals of value were seen. A few ducks and prairie-chickens were the only game noticed.—*Geo. Edwards, D.L.S., 1907.*

31. This township can be reached by wagon from the town of Stettler on the Lacombe branch of the Canadian Pacific railway, by way of the Handhills trail which is a fairly good road during the summer months, except in a wet season. There are a few creeks and sloughs not as yet bridged which are difficult to cross. The soil is sandy loam and clay loam, very good for agricultural purposes. The surface is prairie with no timber or brush. Large quantities of hay can be cut on the meadows throughout the township. The water in this township is fairly good. Bullpound creek flows from what is known as the 'golden' hay meadow, at the southwest corner of the township easterly across the township, and contains water fit for domestic use, while along its banks are found springs of good water. Good water can also be obtained by digging. There are no water-powers. The climate is inclined to be dry but subject to extremes of drought and moisture. It was very wet this season, raining nearly every day during the month of June. There were no summer frosts up to September 1. There is no wood, but lignite coal has been found in the adjoining townships and no doubt will be found in this township in sufficient quantity for the use of the settlers. No stone quarries, minerals or mineral bearing rocks are found in the township, but plenty of field stone exist. Wild geese and ducks are very plentiful in this township; a few prairie-chickens and a few small animals were seen. This township is well adapted for ranching as there is good pasture, good water and lots of hay in the meadows scattered through the township.—*Lewis Bolton, D.L.S., 1908.*

32. This township can be reached by wagon from the town of Stettler, on the Lacombe branch of the Canadian Pacific railway by way of Handhills trail, which is a fairly good road during the summer months, except in a wet season. There are a few creeks and sloughs not bridged as yet that are difficult to cross. The soil is partly clay loam and partly sandy loam, very good for agricultural purposes. The surface is prairie with no timber or scrub. Considerable hay can be cut in the meadows throughout the township and around the lakes. The water is generally alkaline, a few springs are found in the ravines and around the shores of the lakes, of fairly good water. Wolf creek, a small stream flowing into Dowling lake, contains water that can be used for domestic purposes, but dries up early in the season. The water in Dowling lake, in fact in all the lakes, is alkaline. Good water can be obtained by digging. There are no water-powers. The climate is inclined to be dry, but subject to drought or excessive rains in some seasons; this season the month of June was very wet, raining more or less every day. There were no summer frosts up to September 1. There is no wood. Lignite coal is found in the adjoining townships and no doubt will be found here in sufficient quantity for fuel for the use of settlers. No stone quarries or minerals were found, but there is plenty of field stone. Great numbers of wild geese and duck are found on the lakes in this township, especially on Dowling

Range 15—Continued.

lake. Some prairie-chickens, a few antelope and coyotes but very few wild small animals were seen.—*Lewis Bolton, D.L.S., 1908.*

63. This township is reached by way of the main trail fromVegreville on the Canadian Northern railway to lac la Biche, and a branch trail from this leaving the main trail about four miles north from Whitefish Lake postoffice, the main trail from Vegreville to Saddle lake is in splendid condition throughout almost the entire year, while from Saddle lake to Whitefish lake it is good during the dry season, but very bad in the spring. From Whitefish lake to a lake in sections 7 and 18 in township 63, range 14, the trail is in fair condition during a dry season of the year. From this lake, however, it would take a considerable amount of work to open up the present trail through this township for summer use, as advantage was taken of all lakes and streams in making my trail through it. The surface soil is very shallow in most cases, being from one to six inches in depth, and of a sandy nature. The subsoil is of a sandy clay nature throughout in some cases merging into the surface soil, so that it is hard to distinguish between surface soil and subsoil. The muskegs of the township are of a mossy nature or ranked as fourth class, the upland soil being classed as second and third, with a greater part of the upland portions suitable for agricultural purposes. The township is of a rolling nature, and is heavily timbered throughout. The greater portion of the timber is made up of poplar and balm of Gilead, from three to fourteen inches in diameter, there being also a scattering of birch from three to ten inches, while scattered spruce is found throughout the entire township from six to eighteen inches. Some jackpine ridges occur scattered throughout the township the timber being from six to fourteen inches in diameter. The muskegs are timbered with scrub spruce and tamarack from two to six inches in diameter. A large swamp with dense willow is found in the northerly and westerly parts of section 20. Very little hay is to be found in this township, there being only a very small number of small meadows from which good hay might be cut. A little might also be cut in patches along the creeks, through the southerly portion of this township. The water of the township is all fresh and the supply is sufficient and permanent. A number of creeks from eight to fifteen feet in width occur in the southerly portion of the township. One of these flows through sections 6, 7, 8, 9 and 10, in an easterly direction converging therefrom, and to a southerly direction, flowing through sections 2, 3, 10, 11, 14; here it converges with one from the west flowing through sections 20, 17, 16, 15, 14 and 13, eventually emptying into Whitefish creek. The volume of water through these streams is very small during the dry season of the year, there being from six inches to two feet of water in the main stream, the current not being at all strong. Beaver river enters this township in section 36 and flows southerly through sections 36 and 25, leaving the township in the southeast corner of section 25. This stream is about sixty feet in width, and from two to four feet deep through this township, the current being rather sluggish. The river here flows through a valley from one-quarter to one-half mile in width and about one hundred feet in depth. The township is in little or no danger from floods owing to the rolling nature of the country. No water-power is available in this township. The climate appears to be suitable for agricultural purposes. Wood is the fuel most readily obtainable here and may be procured in abundance in any part of the township. No coal or lignite veins are known to occur in the township. No minerals of economic value were noticed. Black bear and moose appear to be very plentiful in this township, and I believe caribou are also found here. Partridge are plentiful but prairie-chickens are unknown.—*W. H. Waddell, D.L.S., 1908.*

TOWNSHIPS WEST OF THE FOURTH MERIDIAN.

Range 16.

27. This township is accessible by a good trail from Gleichen, which is distant about sixty miles. The soil is chiefly clay, one-third of the area being suitable for agricultural purposes, and the remainder good ranching land. The surface is open prairie with no timber, over half of it being hilly. There are no streams, the only available water being in a few sloughs. The only place where good water was found was in a slough on the east boundary of section 23. Good hay land is found in sections 5 and 6. There is no fuel supply in the township, but coal of fair quality can be had within 15 miles. There are no stone quarries or minerals of economic value. Game is not plentiful, only a few ducks being seen.—*Geo. Edwards, D.L.S., 1907.*

28. The route to this township is by a good trail from Gleichen. The soil is chiefly clay suitable for ranching purposes, but the surface is too rough for agricultural purposes except in the northern part of the township, where there are several sections of good farm land. The surface is open prairie without any timber. There is good upland hay on several sections in the west half of the township. Little Fish lake covers a large part of sections 5, 6, 7 and 8. It contains good water, and in some places has a depth of twenty feet. There are also some small streams of good water. The climate is good, and there is no special danger from summer frosts. The nearest available fuel is twelve miles distant. There are no stone quarries or minerals of economic value. A few ducks, geese and prairie-chickens were seen.—*Geo. Edwards, D.L.S., 1907.*

31. This township can be reached by wagon from the town of Stettler, on the Lacombe branch of the Canadian Pacific railway, by way of the Handhills trail, which is a reasonably good road during the summer months except in wet seasons. There are a few creeks and sloughs not bridged as yet that are difficult to cross. The soil is chiefly sandy loam, good for agricultural purposes. The surface is prairie with no timber or scrub. Small hay meadows are scattered throughout the township and at the southeast corner. What is known as the Golden hay meadow is situated where large quantities of hay are cut every year by the ranchers. The water in this township is not very good, being slightly alkaline. That in the small lakes is not fit for domestic use. There are a few springs throughout the township, but the water is more or less alkaline. One branch of Wolf creek crosses the northwest corner of the township. The water in it is fairly good, but the supply is small. Good water can be obtained by digging a reasonable depth. There are no water-powers. The climate is inclined to be dry, but is subject to extremes of drought and moisture. There were no summer frosts this season. There is no wood, but lignite coal has been found within the township, and when properly opened up settlers will be able to obtain a supply for their use. No stone quarries, minerals or mineral bearing rocks were seen in the township, but plenty of field stone exist. There is very little game in the township. A few wild ducks around the small lakes and ponds and a few prairie-chickens were all that were met with.—*Lewis Bolton, D.L.S., 1908.*

32. The Handhills trail from Stettler leads close to the westerly boundary of this township. This trail is a fairly good road for wagons during the summer months, except in a very wet season. There are several creeks and sloughs not yet bridged that are difficult to cross. The soil is chiefly sandy loam and clay loam suitable for agricultural purposes. The surface is prairie, generally rolling, with no timber or scrub; some small meadows are scattered through the township. The supply of hay is very limited, there being only a few small meadows in the township, none of any considerable area. The water is not good, being slightly alkaline. Some small lakes contain water not fit for domestic use. One branch of Wolf creek containing a small amount of fairly good water crosses the southwest corner of the township. Good

Range 16—Continued.

water can be obtained by sinking wells. There are no water-powers. The climate is inclined to be dry, but subject to extremes of drought and moisture. No summer frosts occurred this season. There is no wood, but lignite coal has been found along the banks of Wolf creek; no doubt a sufficient supply can be obtained for the use of settlers. No stone quarries, minerals or mineral bearing rock were found in the township, but plenty of field stone occur. Game is not plentiful. Wild geese and duck are found around the lakes and sloughs. A few coyotes and antelope were seen. Smaller animals were very scarce.—*Lewis Bolton, D.L.S., 1908.*

41. This township is for the most part a rolling country with scattered clumps of poplar and willow bush. The southwest corner is broken by the valley of Battle river which flows southeasterly through sections 18, 7, 8, 5, 4 and 3; and Bigknife creek which flows easterly through sections 6, 5, 4 and 3 where it empties into Battle river. The soil is rich sandy loam with clay subsoil. That part of the township southwest of Battle river is broken and rough with large clumps of willow bush, poplar, balm of Gilead and spruce. The township is well settled. Good crops of grain, principally wheat and oats are grown and vegetables such as potatoes, cabbage, beets, carrots and cauliflower. Trails through the township are well travelled, but there has been only a small amount of work done on the road allowances. Wood as fuel is plentiful. There were no indications of mineral seen. Game consists chiefly of duck, but there are a few prairie-chicken, coyotes and lynx. Hastings coulée post-office and general store are situated in the northwest quarter of section 23.—*T. A. Davies, D.L.S., 1907.*

Range 17.

27. The route to this township is by a good trail, rather hilly from Gleichen. The soil is chiefly clay producing good grass and well adapted for ranching. The surface is open prairie and mostly very hilly. There is no timber except along Red Deer river where there is considerable small timber consisting of willow, birch and cotton-wood. There is considerable good upland hay in the centre and northern portions of the township. Red Deer river traverses the township from section 18 to section 2. The valley of the river is about one mile wide, with banks four hundred feet high. The current of the river is swift, its width varies from five to fifteen chains and its depth at low water is two to ten feet. The water is good. There are no rapids or falls that could be utilized for power. There are a few springs and small streams of good water. The climate is good, and only the average danger of summer frosts. The only fuel obtainable is wood along the river, but the large timber has mostly all been cut away. Indications of coal are seen in some of the coulées along the river. Coal is obtainable fifteen miles west. Stone can be had all along the river but no quarries have been opened up or worked. No minerals were noticed. A government ferry is located on section 4. There are also fords at two or three places where the river can be crossed in low water. Geese, ducks and prairie-chickens are plentiful. A few deer are seen occasionally along the river.—*Geo. Edwards, D.L.S., 1907.*

28. This township can be reached with wagons by way of the Handhills trail, which is a fairly good road during the summer months, except in a wet season. Some of the creeks and sloughs not yet bridged are difficult to cross. The soil is partly of chocolate clay and partly of sandy loam, but is more or less mixed with stone, making it difficult to cultivate although it is very productive. Very heavy crops of grass grow all through the township; this season hundreds of tons of excellent hay were cut on the uplands. The surface is prairie with no timber or scrub except a little in

the ravines. Part of the township is considerably cut up with deep ravines running towards Red Deer river, but in other parts of it is gently rolling. No hay meadows of any great extent occur in the township but hay can be cut on all the uplands; this year the crop was excellent. The supply of water is very limited, there being very few sloughs or creeks; that in Fish lake is not fit for domestic use. A few springs in the ravines contain very good water, and it can be obtained by digging. There are no water-powers in the township. The climate is inclined to be dry and subject to extremes of drought and moisture. This season was very wet during the month of June, while last season was very dry. No summer frosts occurred this summer until after September. There is no wood in the township. Seams of lignite coal were seen in some of the ravines in the southwesterly portion and no doubt plenty for the use of settlers can be obtained in the township. There are no stone quarries or minerals but there is plenty of field stone. Great numbers of water-fowl were seen around Little Fish lake. Prairie-chickens and small animals were not plentiful; a few antelopes were seen. The township is well adapted for ranching. The grazing is excellent, especially that part around Little Fish lake, where large quantities of hay were cut this season.—*Lewis Bolton, D.L.S., 1908.*

29. This township can be reached from the town of Stettler on the Lacombe branch of the Canadian Pacific railway by way of the Handhills trail, which is a good road during the summer months except in a wet season; there are a few creeks and sloughs not yet bridged which are difficult to cross with heavy loads. The soil is chiefly clay loam and sandy loam good for agricultural purposes. The surface is prairie except in the ravines and on some hillsides where there is poplar and willow. The township is considerably cut up with deep ravines, especially the southerly and westerly portions; the remainder is gently rolling prairie and good for agricultural purposes. There are a few balm of Gilead and poplar trees, in the ravines, large enough for building purposes but the timber in general is small but good for fuel. Considerable hay has been cut in the meadows and uplands throughout the township. There are quite a number of springs in the ravines containing very good water, these being the only supply in the township. Good water can be obtained by digging fifteen or twenty feet. There are no water-powers. The general indications suggest a dry climate but some seasons are extremely wet while others are extremely dry. This season was very wet during the month of June. No summer frosts occurred this season before September. Considerable wood can be obtained, in the ravines and on hillsides, for fuel. No doubt coal can be found in the ravines. We did not observe any in this township but did in the adjoining township. Plenty can be easily obtained for the use of setlers. There are no stone quarries or minerals but abundance of field stone can be had. Very little game is found in this township; there being no sloughs or lakes; there are no water-fowl. A few chickens and coyotes and an occasional antelope were all the game found in the township. Sections 1, 12, 13, 14, 15, 16, 21, 22, 23, 24, 25, 26, 27, 28, 33, 34, 35 and 36 are fit for agricultural purposes, while the remainder is only fit for ranching, being very rough and hilly and cut up with deep ravines.—*Lewis Bolton, D.L.S., 1908.*

30. This township can be reached from the town of Stettler on the Lacombe branch of the Canadian Pacific railway, by way of the Handhills trail, which is a very good road during the summer months except in a wet season; there are a few creeks and sloughs that are not as yet bridged which are difficult to cross. The soil is chiefly sandy loam very good for agricultural purposes. The surface is chiefly prairie; the northerly part of the Hand hills is in this township and the surface is considerably broken by ravines running down from the higher elevations to the foot

Range 17—Continued.

of the hills. In these ravines there is some poplar and willow; some of the poplar is large enough for building purposes, but the supply is small and the settlers in the township have cut a good portion of it for their use. There is also considerable large willow suitable for fence stakes and the settlers are availing themselves of it for fencing purposes. Considerable hay was cut on the uplands this season also in the meadows on the top of the Hand hills. There appeared to be a good crop of grass on the higher parts of the hills. There are quite a number of springs in the ravines in the Hand hills containing very good water, besides these there is very little water in the township. Good water can be obtained by digging fifteen or twenty feet. There are no water-powers. The climate is on the average not so dry as the adjoining low lying lands. Showers appear to fall among the hills and pass over the lower lands. The crop of grass was much heavier on the top of the Hand hills than on the low lands adjoining. There were no summer frosts this season before the end of August. There is considerable wood in the ravines and on the hillsides for fuel. Lignite coal has been found in considerable quantities in the northerly part of the township in sections 21 and 22. Considerable has been taken out of section 21, but the seam at present is on fire and should be extinguished or a great quantity of coal will be destroyed. There are no minerals or mineral bearing rocks. Very few water-fowl are found in this township. There are a good many prairie-chickens, a few deer but not many small animals. This township is well adapted for ranching, there being good pasture, plenty of hay and good shelter for cattle in the ravines in winter time, and good water. There are at present a good many settlers in the township, mostly ranchers.—*Lewis Bolton, D.L.S., 1908.*

31. This township can be reached by wagon from the town of Stettler, on the Lacombe branch of the Canadian Pacific railway, by way of the Handhills trail which passes through this township. This trail is a very good road during the summer months except during a wet season, as there are a few creeks and sloughs not yet bridged that are difficult to cross with heavy loads. The soil is clay, clay loam and sandy loam; in some of the flats there is gumbo. The loamy soils are good for agricultural purposes. The surface is prairie with no timber or brush and gently rolling. There is not a great quantity of hay in the township. The sloughs and low meadows are about the only places that hay can be cut, and they are few and small. The water is more or less alkaline. That in the sloughs is the best, but they dry up early in the season. There are a few springs in the ravines forming the head of Wolf creek, but they are more or less alkaline. The supply is very limited in the township; good water can be obtained by digging. There are no water-powers in the township. The climate is inclined to be dry and subject to extreme drought and extreme moisture. This season was very wet during the month of June, while last season was the reverse. There is no wood in the township. Lignite coal is found in the adjoining townships, and no doubt a sufficient supply can be obtained for settlers in this township. No stone quarries were seen in the township, but there is an ample supply of field stone for all purposes. There is very little game of any kind in this township, there being very few sloughs or ponds for water-fowl and no bush or scrub for the shelter of wild animals.—*Lewis Bolton, D.L.S., 1908.*

32. This township can be reached from Stettler, a town on the Lacombe branch of the Canadian Pacific railway, by way of the Handhills trail that passes through this township. This trail is a fairly good road during the summer months except in a wet season. There are a few creeks and sloughs not yet bridged which are difficult to cross with heavy loads. The soil is clay, clay loam and sandy loam, and in the flats of Wolf creek and in many other low places, gumbo. The loamy soils are good for

agricultural purposes. The surface is prairie with no timber or brush, except a few bunches of willow along the banks of Wolf creek. Considerable hay can be cut in the meadows throughout the township; they are mostly small and scattered through the township. The water is more or less alkaline, a few springs in the ravines have fairly good water. That in Wolf creek can be used for domestic purposes, but it is not very good. The supply in the township is very limited, but good water can be obtained by digging. There are no water-powers. The climate is inclined to be dry and subject to extremes of drought and moisture. This season was very wet through the month of June, while last year was the reverse. There were no summer frosts up to September 1. There is no wood, but lignite coal has been found in the adjoining townships, and no doubt a supply for fuel for settlers will easily be obtained. No stone quarries were found, but there is plenty of field stone for all purposes. No minerals or mineral bearing rocks were seen in the township. Very little game was seen; there are a few ducks and geese in the small lakes and ponds and a few prairie-chickens, also a few coyotes and badgers, but very few small animals.—*Lewis Bolton, D.L.S., 1908.*

41. This township is broken up into five parts by Battle river, which enters on the north boundary of section 35, flows southerly and leaves the township on the east boundary of section 13. Meeting creek which enters near the northwest corner of section 19, flows in an easterly direction into Battle river close to the quarter section corner on the east boundary of section 26; Willow creek, entering on the south boundary of section 4, which flows northerly through sections 4 and 9, turns to the northwest and leaves the township on the west boundary of section 19, and Bigknife creek, which enters on the south boundary of section 3, flows northerly through sections 3 and 10, turns to the east and south and leaves the township on the east boundary of section 1. The surface between these valleys is rolling, with scattered clumps of poplar and willow bush. The soil is generally a sandy loam with clay subsoil, and in some few parts a sand subsoil. Most of the settlers have made extensive improvements, harvesting large crops of wheat, oats and flax. The quarter sections were almost all fenced, large barns and houses being built. Meeting creek, a stream of muddy water and slightly alkaline, is generally twenty-five feet in width, three feet deep, and flows at an approximate rate of two miles per hour. Grain can be raised in the valley, which is fifty chains wide, as was shown by a very fine crop of oats in the eastern part of section 30. Farther east in the valley good wild hay grew luxuriantly. There are clumps of spruce and poplar from two to ten inches. Willow creek, with a general width of twenty feet, two feet deep and flowing at approximately one mile per hour, contains good drinking water. Grain was being grown in this valley also. Good wild hay is plentiful, as is also spruce, poplar and tamarack. Bigknife creek, ten feet across, average depth one foot and with a current of one mile per hour, flows through a rough and broken coulée varying from ten to twenty chains in width. Spruce and poplar two to eight inches in diameter grow scattered and in clumps. The water in the creek is pure. A few small lakes and sloughs, which are free from alkali, are scattered throughout the township. Large numbers of duck were seen. There were a few coyotes and lynx.—*T. A. Davies, D.L.S., 1907.*

42. Battle river flows through the centre of this township in a southerly direction. Sections 25 to 36 are rolling prairies with a few scattered clumps of poplar and willow brush. The soil is a light sandy loam with a clay subsoil. Wild hay does not grow so well as in other parts of the township. Almost all of the settlers are in the southern two-thirds of the township. This is a rolling country with large clumps of poplar and willow bush. Some groves of spruce and birch from two to ten inches in diameter are in the river valley and the many adjoining coulées. The soil is a sandy

Range 17—Continued.

loam with a clay subsoil. Wheat and oats are the principal products; a few of the settlers grow potatoes, cabbage, carrots, beets and other vegetables of good quality. Coal has been located in small quantities in several places along the valley slopes and is used as fuel. Wood, however, is the chief fuel supply. There is one small rapid on Battle river near the north central part of section 16. The river can be forded here. Ducks are numerous and a few coyotes are found. There is one school situated in the southwest quarter of section 4.—*T. A. Davies, D.L.S., 1907.*

43. About one-third of this township is considerably broken by the valley of Battle river and the many coulées which extend into it on both sides of the valley. The remaining two-thirds is rolling, with scattered clumps of poplar and willow bush. The soil is a sandy loam with clay subsoil. There are a few small sloughs of fresh water and one creek of alkaline water, which crosses the north boundary of section 10, the east boundary of section 9 and thence flows into Battle river. Coal was seen in several places along the river valley. The most of the settlement is in the northern half of the township, where some large fields of wheat and oats were growing. Summer frosts did not occur.—*T. A. Davies, D.L.S., 1907.*

Range 18.

27. The route to this township is by trail from Gleichen. The soil is chiefly clay, suitable for ranching; and the surface is open prairie, mostly very hilly. There is no timber except along the banks of Red Deer river, where there are clumps of small willow, birch and poplar. Red Deer river traverses the township from section 31 to section 13. It has a rapid current and the water is good. Its valley is about one mile wide, with hills four hundred feet high. There are no rapids or falls suitable for water-power. There is good upland hay in the north part of the township. The climate is good, and summer frosts not unusually prevalent. There is no fuel supply here, but coal is obtainable in the next township west. There are no minerals, but there is some sandstone in the hills along the river that could doubtless be utilized for building purposes, though none of it has been worked. Geese, ducks and prairie-chickens are plentiful.—*Geo. Edwards, D.L.S., 1907.*

43. Battle river enters this township on the north boundary of section 32, flows southeasterly and leaves the township close to the northeast corner of section 12. The surface generally is rolling, with many large clumps of poplar and willow brush and a few scattered birch. The soil is a rich sandy loam with clay subsoil. No indications of coal or other minerals were seen. The sloughs are free from alkali, and the water is good for drinking purposes. The settlers have not made as many improvements as those in the township to the north in regard to grain growing. Large quantities of good wild hay grow in most of the sections. Close to the quarter section corner, on the east boundary of section 32, is the Ferry Point general store and postoffice. There is a school situated on section 4, and a church on section 30.—*T. A. Davies, D.L.S., 1907.*

44. With the exception of sections 5 and 6, where Battle river flows, this township has an undulating surface, with scattered clumps of poplar and willow brush. There are a few small clumps of poplar from two to six inches in diameter. The soil is a black and sandy loam with clay subsoil. There are few small sloughs, which are free from alkali. The water used is mostly taken from wells. The settlers are well advanced with their farms, growing large crops of wheat and oats. Plenty of good wild hay grows on the uncultivated land.—*T. A. Davies, D.L.S., 1907.*

Range 18—Continued.

60. This township is reached by a trail along the east side of Smoky lake from Pakan. The soil is from four to eight inches of leaf mold over clay, and is suitable for mixed farming. The surface is gently rolling and covered with timber consisting of poplar, spruce and tamarack, also some small white birch. Spruce from ten to fourteen inches in diameter occurs in clumps along the edges of swamps and lakes. The poplar is generally small, being from four to eight inches in diameter, while the undergrowth is willow, hazel, cranberry and saskatoon bush. Small fruits such as raspberries, gooseberries, cranberries and red and black currants are plentiful. Hay in this township is very scarce. There are some small patches of grass on the west side of sections 30 and 31, and on the west side of section 21 along the lake shore. The water is strongly alkaline, except the lake on the west of sections 30 and 31, which is fresh. There are no water-powers. The climate was wet and cold this season. A frost on the morning of July 13 formed a thin coating of ice over our water bucket. There was also a frost on August 21, which froze the crops in township 59, range 19. There is plenty of wood for fuel on every section. There were no stone quarries or minerals seen. Game consists of moose, bear, partridge and duck in season.—*Hugh McGrandle, D.L.S., 1908.*

Range 19.

32. A good trail from Stettler runs into the township at McKee lake. The soil is generally a heavy clay loam suitable for mixed farming. The surface is generally hilly, except on the east side, with small patches of poplar and willow scrub in the hollows. There is no timber of any value and no hay in the township. The water is generally fresh, and a sufficient quantity is found in the sloughs and McKee lake. There is no danger of flooding and no water-power. The climate is dry and subject to summer frost. Wood may be procured in the township to the north, and coal along Red Deer river to the west. There was no coal found in the township, neither stone quarries nor economic minerals. Ducks and geese were seen on the lake and sloughs. —*C. C. Fairchild, D. L.S., 1907.*

44. The surface of this township is generally rolling, but broken by the valley of Battle river, which flows from the northwest to the southeast corner. On that part of the township to the northeast of the valley there are scattered clumps of second-growth poplar and willow brush, and on the part to the southwest clumps of this brush are more numerous and dense. In the north halves of sections 32 and 31 there are a few groves of poplar and birch from two to six inches in diameter. The soil is a rich black and sandy loam with clay subsoil. The main products are wheat and oats of first class quality. Good wild hay grows abundantly. The only body of water, besides a few small sloughs, is Battle river, which enters this township about the centre of the north boundary of section 31, and is here approximately twenty-nine chains in width. It flows in a southerly direction as far as the northeast corner of section 18, where it bends toward the east, gradually becoming narrower through sections 17, 16, 15, 10, 11 and 1, and leaves the township near the centre of the east boundary of section 1, where it is approximately two chains across, its general width. The river has a uniform rate of approximately two miles per hour, and is without falls or rapids. In this township the river bed is soft and impossible to ford. At the time of survey (May) the water was low, and varied from two to ten feet in depth. There was a large number of cattle feeding along the river flat. The only mineral in this township is coal, which lies in pockets along the slopes of the valley. The water of the river and sloughs is free from alkali and good to drink. There were no fish in the river, and duck was the only game seen.—*T. A. Davies, D.L.S., 1907.*

TOWNSHIPS WEST OF THE FOURTH MERIDIAN.

Range 19—Continued.

60. This township is reached by a good wagon trail which follows the east side of Waskatenau creek from Pine Creek postoffice to the southwest quarter of section 5, where it ends. The soil is a sandy loam over clay suitable for mixed farming and grazing. The surface is covered with thick poplar and willow scrub, with clumps or patches of poplar and spruce from six to fourteen inches in diameter. The south third of the township is slightly rolling, with numerous small sloughs. The centre third is mostly all swamp and muskeg, with small spruce and willow, and islands or ridges of small poplar. The north third is slightly rolling, with more green timber, especially in the northwest corner. There are clumps of spruce from eight to fourteen inches in diameter along or near the edge of swamps. There is considerable hay in the township, especially along Waskatenau creek in sections 6 and 7. There are also numerous grass sloughs scattered all over the township, but the slough grass is of a coarse variety. There is a good supply of fresh water apparently permanent, except in very dry seasons. Waskatenau creek, a stream from thirty-five to forty links wide, with banks from four to six feet high, enters the township from the west at the southeast quarter of section 18 and flows southeasterly through sections 6 and 7, leaving the township near the southeast corner of section 6. At present the creek contains but very little running water. Along the course of this stream are large hay sloughs, which would be flooded at every high water. A small stream flows south from the southeast quarter of section 36 through sections 25 and 24, and another through sections 35, 26 and 24 into Smoky lake, but these small streams are not permanent in dry seasons. There are no water-powers. The climate this season was wet and cold, with frosts on July 13 and August 21. There is plenty of wood for fuel in every section. There was no coal or lignite seen, neither stone quarries nor minerals of any kind. Game consists of moose, bear, partridge and ducks in season. Small fruits such as gooseberries, raspberries, cranberries and red and black currants are plentiful in the northeastern portion of the township.—*Hugh McGrandle, D.L.S., 1908.*

63. (North and east outlines.) This township is reached with pack horses, and there is no trail for wagons. Along the east boundary there are a few inches of black loam with sandy clay subsoil. The surface is rolling and suitable for grazing purposes. Some spruce is found in section 25 from twenty to thirty inches in diameter along a large lake extending from the northeast corner across the south boundary. There is no hay in the township except a small quantity along the lake. Fresh water is supplied by this lake, but there is no water-power. The climate is good, with no indications of summer frost. Wood for fuel can be obtained in every section, but no lignite veins, stone quarries, nor minerals of economic value were found. Moose and bear were the only game seen.—*J. L. Coté, D.L.S., 1908.*

64. There is no trail to this township. The soil is very light and stony, and would be more suitable for grazing than farming. The surface is generally rolling. The northwest half, as a rule, is brulé, while the southeast half is covered with various kinds of green wood. There is no timber of any value, nor was any hay noticed. Fresh water was found in numbers of muskegs throughout the township, but the creeks were small and dry in August. No waterfalls were seen, and no water-power can be developed. There is no summer frost, and the climate is good. There are quantities of fuel on every section, but no lignite veins were noticed. There are no stone quarries nor minerals of economic value. Moose and bear are plentiful.—*J. L. Coté, D.L.S., 1908.*

65. A wagon trail from Athabaska Landing to Skeleton lake has been opened this summer and passes through the south tier of sections of this township. It is in fair condition. The soil is generally light, but about one-third of this township may be classified as second-class soil, being black loam with clay subsoil. The surface is

Range 19—Continued.

generally wooded, though most of it is dry on account of the fires which occurred a couple of years ago. There is no timber nor hay. Flat lake covers parts of sections 19, 30 and 31, while Skeleton lake covers parts of sections 12, 13 and 14. Both lakes contain fresh water. There is also a couple of small creeks giving an ample supply of fresh water. There are no water-powers. The climate is good, and there is no indication of summer frost. Wood as fuel can be obtained in every section, but no lignite veins were observed in the township. There are no stone quarries nor minerals of economic value. Game is rather scarce, but whitefish is plentiful in Skeleton lake.—*J. L. Coté, D.L.S., 1907.*

67. The government wagon road from Athabaska Landing to lac la Biche passes close to the south boundary of this township. The soil, as a rule, is composed of two or three inches of black loam, with a brown loam or clay subsoil. It is suitable for mixed farming. The surface is covered in places with poplar and birch bush chiefly, with open brulé. Pine creek flows through the southeast part. There is some good spruce timber in the west half of section 35 and the east half of section 34, varying from twelve to thirty-six inches in diameter. Upland hay might be cut along Pine creek valley, with a little clearing, for feeding purposes, but there is no open hay land. Fresh water is always obtainable from Pine creek, as well as from small muskegs throughout the township. No land is liable to be flooded. The only available water-power is on Pine creek, a stream from thirty to forty feet wide, with a current of two and one-half or three miles an hour; the valley is about one hundred feet deep. The climate is good. No indications of summer frosts were noticed. Wood as fuel is obtainable on every section, but no lignite veins were seen. There are no stone quarries nor minerals of economic value. Moose and bear were found.—*J. L. Coté, D.L.S., 1908.*

Range 20.

34. The best route for reaching this township is by a good wagon trail which runs from Stettler on the Lacombe branch of the Canadian Pacific railway to the Hand hills via Big Valley creek, and which passes through this township, entering it in section 32 and leaving it in section 4. The soil averages from three to six inches of black loam or sandy loam over a clay or sandy clay subsoil, and may be described as mostly third class and good ranching country, but in the extreme west of the township there is some fairly level land which would be suitable for mixed farming. The surface is mostly rolling or steeply rolling prairie with scattered clumps of gray willow and poplar brush. There is no timber of any description. Small hay meadows are scattered all through the township. Water is fairly plentiful, there being numerous fresh water ponds scattered all through the township and in sections 26 and 27 there is a lake called lake No. 1 which is ten or twelve feet deep and which is very milky in appearance, but is only very slightly alkaline. Also in sections 19, 30 and 31 there is a small fresh water creek, which has pools of water along its course. No water-power can be developed. The climate is similar to that of the Stettler district and summer frosts are rare. Wood for fuel can be obtained in small quantities all through the township, there being scattered clumps of dry willow and poplar two to three inches in diameter. There are no coal or lignite veins, stone or minerals. There is no game.—*R. H. Cautley,, D.L.S., 1907.*

60. This township is reached by a good wagon trail which follows the east side of Waskatenau creek from Pine Creek postoffice to the southwest quarter of section 5, township 60, range 19, thence by a rough trail along this creek to the southwest corner of section 18. It may also be reached by a wagon trail following along the east side of Sucker creek from the bridge on the Fort Saskatchewan trail to the northeast corner of section 35, township 59, range 20, but this trail would be almost impassable in wet sea-

Range 20—Continued.

sons as it follows a chain of grass sloughs which would be flooded. The soil of this township is a light loam over clay which is suitable for mixed farming and stock raising. The surface is level and swampy with numerous grass sloughs and is covered with timber consisting of poplar, cottonwood and spruce, from four to eight inches in diameter, with some small tamarack. There is some green spruce in sections 15 and 16, from ten to fourteen inches in diameter. The timber in the interior of the township is mostly firekilled. Hay is plentiful along Waskatenau creek and its branches and in numerous sloughs in the southern part of the township. The water except that in Waskatenau creek is alkaline and is obtained from swamps or sloughs. There is no flooded land except along this creek. There are no water-powers. The climate this season was wet and cold with summer frosts. There is plenty of wood for fuel in every section. There are no stone quarries or minerals found in the township. The only game seen was moose, bear and partridge.—*Hugh McGrandle, D.L.S., 1908.*

63. (North and east outlines.) This township is reached by means of pack horses as there is no trail for wagons. Along the east boundary the soil is poor, much of it being muskeg with ridges of sand, except in section 1 where it is a clay soil. The surface is level but unsuitable for farming on account of the muskegs. There is no timber of any value, nor is any hay found in the township. Plenty of fresh water can be obtained from the muskegs but there is no water-power. The climate is good with no indication of summer frost. Wood for fuel can be obtained in every section but no lignite veins, stone quarries nor minerals of economic value were found. Moose and bear were the only game seen.—*J. L. Coté, D.L.S., 1908.*

64. From Athabaska Landing there is good road to Pine Creek postoffice, and from there to this township there is a rough trail, part of which we repaired and produced into the township. The soil generally is light and suitable for mixed farming. Most of the country is burnt, except for some bluffs of green woods and the twelve southern sections, which have not been touched by fire. There is no timber of any value. Thirty or forty tons of hay could be cut along the small creeks. Two creeks cross the township from the south, flowing north towards Flat lake. They are about twenty links wide, and give an ample supply of fresh water. No land is liable to be flooded. There are no waterfalls, and no water-power could be developed. The climate is good, with no summer frosts. Wood as fuel is available on every section, but no lignite veins were noticed. There are no stone quarries nor minerals of economic value. Moose, bear and deer were seen.—*J. L. Coté, D.L.S., 1908.*

67. There is no trail to this township, except a sleigh trail from Athabaska Landing following the correction line on the south side of the township. The soil is poor and suitable only for grazing purposes. The southern part of this township is practically all muskeg, while the northern part contains several large lakes, with poplar ridges. There is no hay and no timber of any marketable value. Fresh water can always be obtained in abundance from the lakes and muskegs. No land is liable to be flooded. No water-power can be developed. Wood as fuel can be obtained on every section, but no lignite veins were noticed. There are no stone quarries nor minerals of economic value. Moose, caribou and bear were seen.—*J. L. Coté, D.L.S., 1908.*

Range 21.

59. This township is reached by a wagon trail on the east side of Sucker creek. It commences at the bridge over this creek on the trail to Fort Saskatchewan and enters the township at the southeast corner of section 25. It then follows a chain of

Range 21—Continued.

wet sloughs, and would be impassable in wet weather. The soil is a black loam over clay, and is suitable for mixed farming. The surface is comparatively level or slightly undulating and covered with timber and willow scrub. The timber consists of poplar, cottonwood and spruce, from four to eight inches in diameter, and a few scattered spruce, from ten to fourteen inches in diameter, suitable only for settlers' use. Most of the timber is firekilled, especially that portion south of Sucker creek. The portion north of the creek is mostly swamps and sloughs, with islands and ridges of poplar. There is a large quantity of good hay along the creeks and sloughs in the south part of the township. The water is fresh and the supply sufficient and permanent from the numerous small ponds throughout the township. Sucker creek, a stream from fifteen to twenty-five links wide, flows in a southeasterly direction through sections 30, 29, 20, 16, 15, 22, 23 and 24. This creek flows through a hay slough with a slow current. The banks are clay and from three to four feet high. It freezes to the bottom in winter, and is dry in dry seasons. There is no water-power. The climate was cold and wet this summer, with occasional frosts. There is plenty of wood for fuel and building in almost every section. There are no stone quarries or minerals of economic value found in the township. Game consists of bear, moose and partridge.—*Hugh McGrandle, D.L.S., 1908.*

60. This township is reached by a wagon trail from the Fort Saskatchewan road along the east side of Sucker creek to section 2 and follows the creek to the north boundary of section 22. From section 14, township 59 the trail follows a chain of sloughs and can be travelled only in dry seasons. The soil is a rich black loam from three to eighteen inches deep over clay. It is suitable at present for small farming or stock raising only, as the township is very swampy with patches of dry land. The swamps are shallow and will no doubt dry up and make good meadow land when the timber is removed. The surface is very level and covered with timber with the exception of some open muskegs and grass sloughs consisting of poplar, spruce and some tamarack, from four to eight inches in diameter. There is also a few scattered spruce, from ten to twelve inches in diameter. There is a clump of spruce, from ten to fourteen inches on the north half of section 26 and the south half of section 35. There is a large quantity of hay in this township, especially on both sides of Sucker creek and on the numerous sloughs in every section. The grass in the west portion of the township is of a very poor quality being mostly coarse swamp grass. The water is alkaline in the numerous small ponds in the swamps and sloughs throughout the township. Sucker creek, a stream from twenty-five to thirty links wide and about two feet deep, flows in a southeasterly direction through sections 2, 11, 15, 14, 22, 27, 28, 32 and 33. It has a slow current, and flows through a grass slough from fifteen to thirty chains wide. The banks are from four to five feet high and if the creek should rise above them most of the swamps and sloughs in the township would be flooded. There is no water-power, stone quarries or minerals but there is plenty of wood for fuel on every section. The climate was wet and cold this summer with occasional frosts. Game seen consisted of moose, bear and partidge.—*Hugh McGrandle, D.L.S., 1908.*

64. This township is about five and a half miles east of the trail from Edmonton to Athabaska Landing; it is a good wagon road. There is an old winter trail from this into the southern sections, and a winter and hay trail runs from a more northerly part of it into the northerly centre of the township, otherwise there are no roads. The surface is rolling, undulating in the southern portion and rolling more heavily in the northern sections which are somewhat broken by the creek valleys, which, flowing northward, deepen in their courses and become more ravine-like. The largest of these called Pine creek intersects the township approximately about the middle. Its valley

Range 21—Continued.

is broad and somewhat shallow, with shallow swamps bordering the stream over the greater portion, but towards the north line the valley becomes more of a ravine and the swamps disappear. Most of the swamps appear to be shallow and easily drained and would probably make good land. They are, as a rule, timbered with spruce and tamarack and brush mostly of small size and usually under four inches in diameter. The remainder, and by far the greater portion, of the surface is rolling upland, the soil a stiff clay covered by a scanty deposit of black loam. The greater portions appear to have been destroyed by the fierce bush fires that destroyed the large timber which seems at one time to have covered the township, and of which some few groves and clumps still remain along the east boundary in windfall of the same nature. The growth over the greater portion is small poplar and willow brush, the latter running from a few feet to twelve feet high. The timber is useful only for fuel and local purposes, the few clumps of large spruce and poplar covering but small area. The clay soil supports a good growth of grass, but only small hay meadows are to be seen along the line of the creeks in old beaver dams, and bordering shallow mud-bottomed lakes of which there are about ten in the township. Though no doubt the clay soil would under exposure and cultivation become workable, it could not be rated higher than third class. The water is swamp water, otherwise fresh and good, but signs of iron impregnation were found in Pine creek in section 5. The creeks are either lake-fed or swamp-fed and depend on rainfall. They are not likely to flood to any extent and are not available for water-power even on the largest streams. Fuel is the small timber covering the township, sufficient for local use for a few years. No coal, lignite, stone or other minerals were observed, and no game was seen.—*L. R. Ord, D.L.S., 1907.*

66. The trail from Athabaska Landing to lac la Biche crosses the southeast corner of this township and is in fair condition. The soil is rather poor being composed of sandy ridges and muskegs and partly covered with spruce swamps and would be suitable for mixed farming when drained. The surface is wooded with poplar and spruce of small size. There is no timber, nor hay. Pine creek crosses the southeast corner and there are a couple of small creeks having their sources in the numerous swamps distributed throughout the township. The climate is good while fuel is plentiful on every section although no lignite veins were observed. There are no stone quarries nor minerals of any economic value. There is very little game.—*J. L. Coté, D.L.S., 1907.*

67. There is no trail to this township except the one opened by me across the township from west to east. The soil throughout is light, but suitable for mixed farming. About twenty-five per cent is muskeg and this lies at the north and south sides of the township. The surface is undulating and is covered with poplar, spruce and willow brush. There is no timber of any commercial value and very little hay land is found in the township. An abundant supply of fresh water is available from the muskegs and several large lakes. The climate appears to be good with no indications of summer frosts. Wood as fuel may be obtained on every section, but no lignite veins, stone quarries nor minerals of economic value were noticed. Moose, caribou and bear were the only game found.—*J. L. Coté, , D.L.S., 1908.*

Range 22,

60. There are no trails to this township except an old pack trail along the north side of the south branch of Sucker creek and this trail is obliterated in many places. The soil is black loam over clay or sandy clay and is suitable for mixed farming. The surface is slightly rolling and covered with timber consisting of poplar, cottonwood

and spruce from six to eight inches in diameter. Along the edges of swamps there are some scattered spruce from ten to fourteen inches in diameter, but not in sufficient quantity for a timber berth. The majority of this timber will be cut in a few years by the settlers farther south. The northwest portion of the township is mostly swamp and muskeg. Good hay is plentiful throughout the township, especially along Sucker creek and a creek shown on the north boundary of section 7. The water is fresh but the supply is neither sufficient nor permanent. A good and permanent supply might be obtained by digging a few feet. The south branch of Sucker creek, a stream from eight to ten feet wide and from one to two feet deep flows in a southeasterly direction through sections 33, 27, 28, 22, 23, 14, 15, 11 and 1. Another stream about the same size flows in a southerly direction across the north boundary of section 7. These streams dry up in summer and freeze to the bottom in winter. The banks are of clay and from three to four feet high and the water will flood the hay meadows only when it is very high. There is no water-power. The climate during the summer was wet and cold with summer frosts. Plenty of timber for building and fuel occurs on every section. There are no stone quarries or minerals of economic value found in the township. Game consists of bear, moose and partridge.—*Hugh McGrandle, D.L. S., 1908.*

64. The surveyed trail from Edmonton to Athabaska Landing passes through the westerly tier of sections; it is a well travelled road. There is also a winter trail from the southwest corner crossing the township to the north of east. It is very little used. and is in poor condition. The soil is a stiff clay except in the swamps where it is covered by the usual swamp vegetable mould. This clay is very tough and could not be placed higher than third class as it will take some years of cultivation to develop into fair land. Much of the surface loam or mould has been destroyed by the fierce bush fires that swept off the heavy growth of timber, of which remains still exist, but a fair growth of grass shows cultivable properties. Tawatinaw river, a stream about fifty links wide, flows in a meandering and slow course at the bottom of a valley a mile wide and over two hundred feet deep through the westerly sections. Some jack-pine groves are found in it while the soil is sandy in places. The remainder of the township is rolling country, being a series of broad valleys or troughs with broad, low separating ridges which run a little east of north, the ridges being clay and the valleys traversed by small creeks with swamp along their borders. The swamps are, as a rule, of small area and appear to be shallow and easily drained. The uplands are covered by small poplar and tall alder and willow, mostly firekilled, though patches of green wood of small size are scattered about. None of this is of any commercial value. In the swamps, spruce and tamarack occur, mostly of small size, usually under four inches diameter, and rarely reaching eight inches, practically of no economic value. except for local purposes. The hay meadows are few and small. The water is a swamp water but otherwise seems to be sweet and good. It is probably altogether derived from rainfall being stored up in the one or two small lakes and the swamps which act as reservoirs. The streams are small, the largest, except the Tawatinaw, being less than ten feet in width, and many of them of local origin. None are of any value for power. The small lakes are swamp lakes and shallow and mud-bottomed. Nothing is known as to summer frosts, but there are settlers gathering in the Tawatinaw valley. The fuel is the small timber that covers the surface, probably available for local use for some years. No coal or lignite beds were seen or heard of. No stone quarries nor minerals were noticed. A few moose tracks were seen, but game was conspicuous by its absence. The township is without doubt suitable for agriculture, and when transportation facilities, such as the railway to Athabaska Landing, develop, it will no

Range 22—Continued.

doubt be settled as the clay will probably prove fertile upon exposure and cultivation.—*L. R. Ord, D.L.S., 1907.*

67. The trail from Athabaska Landing to Lesser Slave lake crosses the southwest corner of this township on the north side of the river, while a good trail goes from the Landing to section 1 on the east side. The part of this township on the west side of the river contains some first class farming land. The soil is composed of about six inches of black loam with a clay subsoil. But near the river it is more sandy. On the east side it is more suitable for grazing purposes. Athabaska river flows through this township; its banks being about two hundred and fifty feet high. Back from it the land is fairly level, and covered with patches of green poplar and willow brush. There is no timber of any commercial value. Two or three hundred tons of hay may be cut in this township beside numerous small sloughs, while along the river banks, there is a good growth of peavine. There is an abundant supply of fresh water from small sloughs, muskegs and the river. The river varies from fifteen to twenty chains in width, with a current of four or five miles an hour. No land is liable to be flooded. No rapids or waterfalls occur in this township. The climate is good, with no indications of summer frosts. Wood as fuel can be obtained on every section but no lignite veins were noticed. There are no stone-quarries, nor minerals of economic value. Traces of moose and bear were seen.—*J. L. Coté, D.L.S., 1908.*

Range 23.

61. A good wagon trail connecting Edmonton and Athabaska Landing passes within a half mile and about parallel to the west boundary of this township. Two wagon trails run from the Athabaska Landing trail into this township and thereby makes it easily accessible. One trail passes through sections 18, 19, 20, 28 and 27 and terminates in section 23, the other through sections 7, 8, 9, terminating in section 16. The soil is composed of about six inches of black loam with a clay subsoil and is quite suited for grain growing. The surface of the westerly half of the township is rolling and covered with poplar bush up to six inches in diameter while the easterly half is nearly level and fully three-quarters muskeg. Between the muskegs is found in many places spruce timber of a fair size and quality. Stony creek runs through the northwest corner of this township. The water in this creek is good and also the water in the lakes in the southeasterly part of the township. There is no hay of any account, neither are there water-powers, stone quarries or minerals of economic value. Game is scarce but fuel consisting of good spruce, tamarack and poplar wood is found in abundance throughout the township. The climate and soil are good and there is every reason to believe that the westerly half of the township will be largely under cultivation in the near future.—*R. H. Knight, D.L.S., 1908.*

62. The Edmonton and Athabaska Landing surveyed wagon trail passes northerly through this township. The trail enters in section 6 and then passes through sections 7 18, 19, 20, 29 and 32. A wagon trail branches from the main trail in section 7 and runs northeasterly through sections 17, 16, 21, 22, 26 and 35 to a saw-mill located about the middle of section 35. This township may be described as gently rolling having a light soil covered with bush. To be more particular in description the following may be said. The westerly tier of sections is broken by the Tawatinaw river valley which ranges in width from one to one and one-half miles and has an average depth of about one hundred and fifty feet. The land along this valley is somewhat light and broken by ravines and small muskegs. The whole valley is covered by poplar up to six or eight inches in diameter, or poplar and willow scrub. The most easterly three tiers of

sections are composed of about sixty per cent muskeg upon which is found dry and green spruce and tamarack up to six or eight inches in diameter, which is of little commercial value. The remaining forty per cent of land is composed of small patches or ridges of land usually covered with poplar but sometimes with jackpine. The remainder of the township can be classed as somewhat rolling covered with a mixed growth of poplar, jackpine, spruce and tamarack, and having about fifteen per cent muskeg. The soil is somewhat poor being of a sandy nature. There is some good spruce timber on sections 21, 22 and 36, but this timber is being cut under permit, for the use of settlers to the south. At the time of survey (June) there were saw-mills cutting this timber. One mill is situated on section 22; the other is on section 35. Good water is plentiful which can be had from the numerous muskegs or from three or four small creeks running out of the township. Hay is scarce but fuel is plentiful. The climate is all that can be desired; slight summer frosts occurred but did no damage. Stone quarry material is not apparent neither are water-powers or minerals of economic value.—*R. H. Knight, D.L.S., 1908.*

63. The wagon trail connecting Athabaska Landing and the Edmonton district runs through this township passing through sections 4, 10, 15, 23, 26 and 35, and thereby affords easy access to the land as a whole. The southwesterly and northeasterly portions of this township are badly broken by the valley of Tawatinaw river. The soil is good and is well adapted for grazing purposes when once cleared of bush, for, where small openings occur, there is found a good growth of hay or peavine. Generally speaking, the whole township is covered with poplars up to four or five inches in diameter. The northwesterly and southeasterly parts of the township are more level and the land somewhat better in quality, though the easterly part of the southeast portion and the westerly part of the northwesterly portion contains considerable timber and is chiefly muskeg. Tawatinaw river affords an excellent and permanent supply of water. The fuel of the settlers consists chiefly of poplar, though, in a few places, spruce and jackpine are to be had but not to any extent. There are no stone quarries nor minerals of economic value. The climate is good and free from summer frosts which was proved this year by the excellent crops of grain and vegetables grown by the settlers.—*R. H. Knight, D.L.S., 1908.*

64. The Edmonton and Athabaska Landing surveyed trail and telegraph line touch the southeast corner of this township and what is known as the 'River Road' branch of the same trail runs through the easterly tier of sections. Otherwise there are no trails or roads into the township. Tawatinaw river flows through sections 1, 2, 12 and 13. The stream is insignificant and valueless as a water-power. It is very meandering and sluggish from fifty to sixty links wide and three feet deep with silt and mud bottom in a secondary valley of ten to twenty chains wide and thirty to sixty feet deep, in the bottom of the main valley which is about a mile wide and probably over two hundred feet deep. The remainder of the township consists of rolling uplands with a general trend to east of north, separated by wide shallow swamps. The uplands and slopes of the valley are covered with small poplar dry and green and tall willow the whole being a second growth of a heavily timbered tract firekilled a number of years ago. The swamps are spruce and tamarack, generally firekilled by a more recent fire which destroyed also much of the second growth on the ridges. A few groves of green spruce are to be found but generally of small sizes, rarely up to six inches in diameter, and the timber with the exception of some patches of jackpine up to eight inches in diameter in the bench lands of the Tawatinaw may be said to be of no commercial value. The soil with the exception of some sandy bench lands in the valley, is clay on the uplands and numerous knolls that push up through the

Range 23—Continued.

shallow swamps, a very tough hard clay which may at some future date when broken up and exposed to frost and weather make fair arable soil, but at present could not be ranked above third class. There are several small swampy lakes that discharge into small creeks flowing east of north, that being the trend of the valleys and ridges. The water is swamp water, but as a rule good, though it appears to be altogether rainfall as there are no spring creeks, the land being too high. The small creek in section 32 is strongly impregnated and coloured by iron, and a deposit of bog iron ore probably exists in the swamps along the westerly tier of sections. The water-powers are of no value whatever. No hay meadows of any size exist. There is plenty of wood for fuel all over the township. No stone quarries or indication of minerals, except the bog iron mentioned, are to be seen. No game at all was seen, except traces of a few caribou.—*Lewis Redman Ord, D.L.S., 1907.*

65. The trail from Edmonton to Athabaska Landing runs parallel to and within one mile of the east boundary of this township but no trail enters it. The west half of the township is very swampy and has only a few patches of good soil while the east half is of superior quality and is generally second class. The southeast corner is rather hilly but vegetation is abundant. There are no water-powers and no hay. Muskeg creek enters this township in section 5 leaving it on section 36, this creek is ten feet wide and two feet deep, and gives an ample supply of fresh water. The climate is good and there is no indication of summer frost. Wood for fuel can be obtained on every section but no lignite was observed. There are no stone quarries nor minerals of economic value. Game is scarce.—*J. L. Coté, D.L.S., 1907.*

66. The trail from Athabaska Landing to Baptiste lake crosses sections 22, 23, 24, 27, 28, 29 and 30 of this township, and is in very fair condition. The soil is generally a black loam with clay subsoil, except the sections adjoining Athabaska river, which are of a sandy nature and are suitable for mixed farming. The surface is wooded with some patches of scattered scrub. On sections 33 and 34, north of the Athabaska, there is a patch of good spruce from seven to twenty inches in diameter. There is no hay. Athabaska river, flowing through sections 32, 33, 34, 35 and 36, and a few small creeks, give an ample supply of fresh water, but there are no water-powers. The climate is good, with no indication of summer frost. Wood as fuel can be obtained in every section, but no coal or lignite veins were observed in the township. There are no stone quarries nor minerals and very little game.—*J. L. Coté, D.L.S., 1907.*

67. The township is reached by the Government trail from Athabaska Landing to Lesser Slave lake, which was in good condition, and passes through the northeast corner. The soil is light on the whole and slightly sandy. It is suitable for mixed farming. The township is broken up by Athabaska river, but otherwise it is level. About thirty per cent is muskeg and the remainder is brulé. There is no timber of any commercial value. No hay land was noticed on the east side of the river, but thirty or forty tons might be cut on small sloughs in sections 32 and 31. Fresh water can be obtained from the muskegs, from which small creeks join the river. No land is liable to be flooded. Athabaska river contains no rapids or waterfalls in this township. The climate is good, with no indications of summer frosts. Wood as fuel can be obtained in every section, but no lignite veins were noticed. There are no stone quarries nor minerals of economic value. Indications of moose, bear and deer were seen.—*J. L. Coté, D.L.S., 1908.*

TOWNSHIPS WEST OF THE FOURTH MERIDIAN.

Range 24.

61. The surveyed wagon trail connecting Athabaska Landing with the Edmonton district passes through the easterly portion of this township. In section 11 a fairly good wagon trail branches westerly for three miles to Tawatinaw river. At about the middle of section 24 another wagon trail branches northwesterly and passes through sections 25, 26, 27 and 34, thence into township 62, range 24. With these numerous trails access to this township is easy. That portion of the country lying to the west of Tawatinaw valley is by far the most fertile, and is well adapted for grain growing. The surface is nearly level or gently rolling and slightly sloping towards the valley. There are a number of small sloughs and muskegs, but these will dry when the land is cleared of bush and will become valuable for hay. In places the growth of bush is thick, being poplar up to six and eight inches in diameter, while in other places the bush is not so thick. There is no prairie. The country east of Tawatinaw valley is of a poorer quality for agricultural purposes. The surface is rolling, and towards the northerly part of the township it is inclined to be broken. There are a few level pieces of land, but nothing of any extent. The soil is somewhat sandy and inclined to be stony. Most of the land is covered with poplar up to six inches in diameter, with underbrush of willow, but there is good jackpine timber up to fourteen inches in diameter found on sections 3 and 4, the south halves of sections 10, 23 and 24, the north half of section 14, the northeast quarter of section 15 and the northwest quarter of section 13. The water of the lakes and streams is permanent and is of a good quality. Tawatinaw river, which runs northerly through sections 5, 9, 16, 15, 23, 26 and 35, is of great benefit. This river will provide the settlers with a permanent water supply. In this stream at certain seasons of the year are found jackfish in abundance. There is good wood for building purposes as well as for fuel. The climate is good and well adapted for growing wheat, oats, barley and other cereals adapted to a northern climate. That the climate is good for such has been proven by the settlers for three or four years past. There are no water-powers nor stone quarries, neither are there minerals of economic value.—*R. H. Knight, D.L.S., 1908.*

62. The Athabaska Landing and Edmonton surveyed wagon trail passes through section 1 of this township, thence northeasterly and northerly, keeping about one mile east of the east boundary. A fairly good wagon trail enters the township in the northerly part of section 13, thence it goes southeasterly through sections 12, 11 and 2, thence westerly through sections 3, 4 and 8 to a large meadow on section 8. Another wagon trail enters on section 3, thence passes westerly through sections 4 and 5 to a hay meaadow on section 6. Neither of these last named trails are good summer trails, on account of the muskegs through which they pass. In this township the southeasterly four or five sections of land are badly broken by the valley of Tawatinaw river. The soil of these sections is somewhat sandy but in places there is a dense growth of grasses and peavine which makes the land suitable for grazing purposes. The remainder of the township has good soil and is level. The only drawback is the amount of worthless bush now upon the land. When once the land is cleared and drained it will be second to none for growing cereals adapted to a northern climate. A large creek runs southerly through sections 32, 29, 20, 17, 8 and 7, into a lake at the southwesterly corner of the township. Along this creek good hay meadows are available, constituting in all about one thousand acres. The northwesterly part of the township contains about three thousand acres of muskegs. The timber of this township is not of commercial value, being composed chiefly of poplar up to ten inches in diameter. There are small patches of scattered spruce up to twelve inches in diameter. The muskegs are thinly covered with spruce and tamarack up to

Range 24—Continued.

six inches in diameter. There is good water to be had in the lakes and low lying lands. There are no water-powers, neither are there stone quarries or minerals of economic value.—*R. H. Knight, D.L.S., 1908.*

63. The Edmonton and Athabaska Landing surveyed wagon trail is about three miles east of this township, but cannot be easily reached by direct line on account of the valley of Tawatinaw river. The best route at present is by way of a trail which leaves the main trail in section 7, township 62, range 23, and crosses Tawatinaw valley in the southerly part of section 13, township 62, range 24. From here a poor wagon trail was cut through the bush, going northerly through sections 13, 24, 25 and 36 to the southeast corner of this township. From this point a trail runs westerly two miles, thence northerly three miles. Almost one-half of this township consists of muskeg covered with small spruce and tamarack up to six inches in diameter or small willow brush. The remainder of the land is nearly level and has a somewhat sandy soil and clay loam covered with bush of either willow and poplar about eight feet high or poplar up to four inches in diameter. On sections 9 and 16 small bluffs of poplar up to twelve inches in diameter are found. There is considerable hay to be had along the borders of the muskegs and in small sloughs on the higher lands. There is an abundance of good water, but there are no water-powers neither are there stone quarries nor minerals of economic value. Fuel composed of poplar, spruce and tamarack is plentiful. The climate is good, being similar to that of the Edmonton district to the immediate south.—*R. H. Knight, D.L.S., 1908.*

64. This township is situated about six miles west of the road from Edmonton to Athabaska Landing. There are no trails or roads into the township. The middle half of the township is swamp while the remainder is rolling clay uplands, bordering the swamps. The general direction of these uplands and the intervening broad swampy valley is a little east of north, the flow of the water in all cases being to the north. A peculiar feature is the small size of the streams, partly explained by the slight fall between the south and north boundaries, as this is about the watershed between Tawatinaw and Athabaska rivers and also because the swamps act as reservoirs, so that there is little scour of waterways. The swamps appear to be generally shallow, and numerous low knolls of clay appear. This clay both on the knolls and on the bordering uplands is of a very hard and impervious nature scarcely penetrated by the roots of the trees. If broken up and exposed to the action of frost and weather it might in time make arable land, but at present it would be called third class. At one time a growth of timber covered the area, but it was fire-swept a number of years ago, and since that time another fire has killed a great part of the second growth. These fires seem to have destroyed most of the surface loam, as the depth of the hard clay is very slight. The timber on the uplands is small poplar and willow up to twelve feet high, of no commercial value. That in the swamps is spruce and tamarack, mostly brulé, though a few patches of, green spruce and tamarack of small sizes rarely up to eight inches in diameter, are still to be found. It is of no commercial value. There are few and insignificant hay marshes though there is fair grazing on the more thickly wooded uplands. The water is swamp water, otherwise fresh and good. The supply is small, dependent on rains and of no value for power. The fuel consists of the timber, which covers the township and which is its only value. There are no rock exposures or minerals to be seen. Game is very scarce; a few caribou tracks were noticed. Even rabbits and grouse are noticeably absent.—*L. R. Ord, D.L.S., 1907.*

65. The only route at present by which to reach this township is by way of a fairly good wagon trail from Athabaska Landing to the south end of Baptiste lake. From

Range 24—Continued.

there a wagon trail was cut southerly a distance of three miles to this township. The trail enters in section 33, goes south and southeasterly to the east boundary of section 15, thence westerly into section 20. The surface of the easterly half of this township is somewhat level and sloping easterly towards a big muskeg running north and south along the east boundary of the township. This muskeg prevents a shorter summer route from the Athabaska Landing trail. The soil of the easterly half of the township is second class and somewhat easily cleared. The westerly half is rough and broken. Sections 7,8, 9, 16, 17, 18, 19, 20, 21 and 29 are decidedly rough and broken, with narrow ravines one hundred to one hundred and fifty feet deep. The land throughout the township is covered with bush varying from light willow and poplar scrub to spruce timber. Of the latter there are patches usually in small muskegs. The soil of the east half of the township consists of about six inches of black loam with a clay subsoil. The westerly half is somewhat lighter soil and inclined to be a sandy clay loam. There is good water but it is somewhat scarce in the easterly parts of the township. Fuel is abundant, consisting chiefly of poplar wood. There are no stone quarries neither are there water-powers nor minerals of economic value.—*R. H. Knight, D.L.S., 1908.*

Range 27.

62. The trail from Edmonton leads through Morinville and Edison to township 61, from here there is only a rough trail to township 62 which was impassable with wagons all season. I was forced to take my outfit the remainder of the distance on rafts down Pembina river. The surface is timbered for the greater part, there being some open places covered with more or less willow or poplar scrub. There is a fringe of spruce along the left bank of the river as far north as the south chord, and north of this it broadens out to an average of half a mile in width. On the right bank the fringe extends to about the same distance north, and from this point the timber extends across the east boundary of the township. There are some open sloughs all of which were full of water at the time of survey. The surface is generally level. The Pembina and a number of small creeks flowing into it provide ample water. There are no falls and consequently no water-powers. Considerable hay could be cut in the sloughs if the water was low enough and I am informed that it usually dries up in time for haying, but the total amount available would not exceed two hundred tons of slough grass. The climate was good except for excess of rain and no summer frosts were noted. There are no stone quarries and no coal or other economic minerals were seen. Moose and jumping deer with partridge, ducks and geese are found. A number of squatters along the Pembina have their holdings within timber berth No. 1296 Block I, but very little good timber is embraced in their claims. The more open parts are suitable for mixed farming.—*C. C. Fairchild, D.L.S., 1908.*

Range 30.

3. At Dry Fork postoffice the trail to this township leaves the Oil City trail, and follows a new surveyed trail in a southwesterly direction for about three miles. There are two trails, which, however, join again in section 15, township 4, range 30. It then runs in a southerly direction to section 33 of this township. From this section a somewhat rough and, in places, wet trail runs in a southeasterly direction to the south part of this township. A more desirable trail to follow to reach the south sections in the township lies along the Oil City trail to the north side of Pine creek, thence southwesterly along a hard and not very hilly trail to the interior. The soil is a light sandy loam. In section 22 a late crop of oats was cut for feed. A large portion of the township is covered with small poplar and willow as follows:—sections 32, 29,

TOWNSHIPS WEST OF THE FOURTH MERIDIAN.

Range 30—Continued.

28, 21, 16, 10 and 11, sections 15 and 22 west of Yarrow creek, and the north part of section 2, also in patches over almost all the other sections. The south portion is rolling, cut by the two branches of Yarrow creek. The westerly and southwesterly part is a series of mountain peaks. No timber of any size is found in the township. The chief fuel is wood and must soon be obtained farther west in the mountains. Summer frosts are common. There are no stone quarries. In sections 12, 13 and 14 iron claims have been staked, but little surface indications of mineral are apparent. Little or no game was seen, but fish are plentiful in Yarrow creek.—*W. H. Young, D.L.S., 1908.*

9. A wagon road connecting with a surveyed road crossing a bridge over Oldman river and leading to Pincher creek, passes to the east of Porcupine hills and follows up Beaver creek into this township. The soil is a sand and clay loam and grows hay and peavine, affording good grazing ground for cattle and horses. The surface is rough and hilly, timbered with fir, spruce, balsam and poplar from three to twenty-four inches in diameter, with some open parts in the southern portion of the township. The timber is suitable for building purposes. The water is fresh but the creeks are small and few and the supply is insufficient during the summer. Beaver creek in the eastern part affords a good supply all the year. There are no water-powers. Frosts occurred during the month of July. Wood is the most readily available fuel. No coal veins, minerals or stone quarries were seeen. Grouse, partridge and trout were apparently the only game in this part.—*T. A. Davies, D.L.S., 1908.*

9. A good wagon road runs from Macleod, northwesterly to and along Beaver creek and from this a fairly good trail branches off and crosses the Porcupine hills through the northerly part of this township to Oldman river. The surface of this northerly part of the township is very hilly and broken. Two creeks having their sources within the township give rise to two valleys in which lie some excellent grazing and farming land, but the quantity is very limited. One of the creeks runs westerly into Oldman river and the other easterly into Beaver creek. The hills are timbered on the northerly sides with fir, spruce, pine and poplar. A good belt of fir, spruce and pine running from six inches to twenty-four inches in diameter runs through sections 25, 26 and 27 but much of this timber has been killed by fire. The soil in the valleys is a good clay loam with a gravelly subsoil. Little natural hay can be cut but good timothy can be grown. There is an abundance of good spring water but no water-power is available. The climate is the usual pleasant and healthy climate of the foot hills and summer frosts do not seem to trouble the settlers except where the land is very high. The timber on the hills will afford ample fuel for a number of years. There are no stone quarries, and no minerals were seen. Game consisting of coyotes, deer and partridge is to be found, but is not now plentiful.—*C. C. Smith, D.L.S., 1907.*

TOWNSHIPS WEST OF THE FIFTH MERIDIAN.

Range 1.

4. The trails to this township lie through township 4, range 30, west of the fourth meridian. In wet weather they are somewhat soft but in dry weather are very good. The soil is about eight inches of loam, with a sandy subsoil and a great many hills surmounted by rocky ledges. The northerly portion, though very hilly, is suitable for farming only in patches. About two and one-half miles from the north boundary is a ridge about one hundred feet high running east and west, and from this the land slopes north to Pincher creek and south to Yarrow creek (north branch).

Range 1—Continued.

This southern slope is rolling and contains much muskeg land, and is covered with poplar and willow scrub except in patches. Victoria peak lies in section 33, and this and a series of peaks run in a southeasterly direction making that portion of the township totally unfit for settlement. There is a quantity of dry timber difficult of access on the southern side of Victoria peak, but no green timber was seen. There are no hay meadows of importance. The fuel is wood, but in the township to the north, coal in large quantities is available. There are no stone quarries or minerals of economic value. Bears, red deer, bob-cats, lynx and other kindred animals are seen in the township.—*W. H. Young, D.L.S., 1908.*

5 and **6**. (East outline.) This line passing through a well settled district is easily followed by wagon trails both south and north of the Crowsnest branch of the Canadian Pacific railway. The soil along the meridian is a black loam with clay subsoil, and in places clay. Grain and hay are grown. The surface is generally a hilly prairie, with patches and large clumps of willow brush and poplar. The water is fresh and of sufficient and permanent supply. Summer frosts occur. Wood and coal are available for fuel. A small coal mine is situated in section 8, township 5, range 30, west of the fourth meridian. It was not in operation at the time of the survey. There are no stone quarries or mineral of economic value. Coyotes and prairie-chickens were the only game seen.—*T. A. Davies, D.L.S., 1908.*

7 and **8**. (East outline.) This line passing through a well settled district is easily followed by wagon trails both south and north of the Crowsnest branch of the Canadian Pacific railway. The soil along the meridian is a black loam with clay subsoil, and in places clay. Grain and hay are grown. The surface is generally a hilly prairie, with patches and large clumps of willow brush and poplar. The water is fresh and of a sufficient and permanent supply. Summer frosts occur. Wood and coal are available for fuel. A small coal mine is situated in section 8, township 5, range 30, west of the fourth meridian. It was not in operation at the time of the survey. There are no stone quarries or minerals of economic value. Coyotes and prairie-chickens were the only game seen.—*T. A. Davies, D.L.S., 1908.*

61. The best route for reaching this township is by way of the old Klondike wagon trail from Edmonton as far as the crossing of Paddle river in township 59, range 3, thence by wagon trail northeasterly through this township and townships 59 and 60, range 2 into section 4, township 61, range 2, whence the surveyor's trail continues easterly to the westerly limit of township 61, range 1. This township contains about 10,000 acres of muskeg which is distributed approximately as follows: Sections 3, 4, 5, 10, 11, 13, 14, 23, 24, 25, 26, 27, 32, 33, 34, 35, 36, the south half of section 9 and the north half of section 28. This muskeg is generally covered with small green tamarack up to six inches in diameter. That portion of the township not covered with muskeg is nearly level and has a soil of rich black loam six inches in depth with a clay subsoil. All this land is covered with a growth of young poplars up to five inches in diameter with usually a windfall of young poplars or large dead spruce which makes clearing difficult. There is no timber of any account other than that suitable for small buildings or for fuel of which there is a large quantity. There is no hay. Good water is plentiful in the vast area of muskeg. The climate is good, being similar to that of the Edmonton district. There are no water-powers, stone quarries or minerals of economic value. Indications of moose and bear were plainly seen throughout the township.—*R. H. Knight, D.L.S., 1907.*

62. The trail from Edmonton passes via Morinville and Edison to township 61, range 27, west of the fourth meridian and thence a rough bush trail leads down the left

Range 1—Continued.

bank of the Pembina river to this township, but this trail was impassable at the time of survey (July), and I was forced to send my supplies down to the work on rafts by the Pembina. The southerly two and one-half miles is covered with willow, poplar and scattered bunches of spruce on the eastern part, and on the western part by muskegs, or more properly, spruce swamps. The northern part is covered with a heavy growth of spruce and poplar. The surface is level. There is plenty of water in the lakes, creeks and Pembina river but no water-power is available. There is only one hay slough in section 13, and probably not more than one hundred tons could be taken off this. The southeastern portion of the township is suitable for mixed farming although it is all included in timber berth No. 1296, Block I. The climate was good except for excessive rains this season, and no damaging frosts were noted. There are no stone quarries, and no coal or other economic minerals were found. There are a number of squatters in the southeast part of the township, but all their holdings are included in timber berth No. 1296. Ducks, geese, partridge and signs of bear, moose and jumping deer were seen.—*C. C. Fairchild, D.L.S., 1908.*

Range 2.

6. This township may be reached by either of two trails from Pincher creek. The Pincher creek to Frank trail passes through the northeasterly portion of the township, while a trail from Pincher creek by way of Mountain Mill postoffice, passes through the southeast corner. Both of these trails are good in dry weather. The eastern sections are mostly settled. The soil is chiefly a clay loam or a black loam with a clay subsoil. The westerly and southwesterly portion is covered mostly with small poplar and willow, except on the hilltops, which have patches of jackpine. There is quite a large hay meadow in sections 7 and 8, consisting of a wild meadow grass. The water is not too abundant as Screwdriver creek dries up in the summer, but excellent vegetables are grown in almost all parts of the township. Beaver creek runs through the southeasterly part, and Southfork river through sections 13, 24, 23, 26, 27, 28, 29 and 30. Frosts are common during the summer. The chief fuel is coal of a soft variety. Some seams are being opened up one in section 4, and another in section 9. There are no stone quarries or minerals of economic value. Deer, bob-cats, grouse and an occasional black bear were seen.—*W. H. Young, D.L.S., 1908.*

12. (North outline.) This township was very hilly and some of the hills showed an elevation of nearly 8,000 feet by our barometer. There is not much timber of any commercial value along this line.—*James Warren, D.L.S., 1908.*

13. This township was reached from Willow creek in township 14, range 1. The trail was fairly good, being nearly all dry with hard bottoms in the streams. There is a good deal of good arable land in this township, the greater part of which is located by settlers who are making a good start in the way of general farming and ranching. There is one large ranch owned by Messrs. Thompson and Reilly who have a large number of cattle and horses. The general surface is rolling covered with clumps of poplar and open patches of prairie. The openings are quite numerous and are taken advantage of by the settlers who have located on some of them. There are some good hay meadows in the northwesterly parts of the township, several hundred tons having been cut this season. The water in the streams is very good, there being no signs of alkali anywhere. There are some timber locations in parts of the township, especially in the northwest portion where some large fir and spruce timber is found that is of commercial value. Also along the easterly slope of a range of hills in sections 9 and 4 there is a good quantity of fir and spruce. There are no streams by which any large

Range 2—Continued.

water-powers could be developed, as they are all small. The climate is liable to summer frosts. Wood is the only fuel now used, though there is a small outcropping of coal on section 21. There is no stone that would be available for building purposes except on sections 30 and 31, which are quite mountainous and rocky. Game is scarce, almost unknown, but the streams abound in speckled trout, which are very fine indeed. The general appearance and surface indications would lead to the impression that the township is better adapted for ranching than any other purpose, as the summer frosts are liable to cut down any grain crop, but root crops thrive.—*James Warren, D.L.S., 1909.*

60. The best route for reaching this township from Edmonton is by way of the old Klondike wagon trail as far as the crossing of Paddle river in township 59, range 3. From this point there is a fairly good wagon trail leading in a northeasterly direction through this township and township 59, range 2, entering township 60, range 2, at the southeast corner of section 2. The surface of this township is gently rolling and has a good soil of black loam about five inches deep with a subsoil of clay which makes the district suited for mixed farming. There is no prairie, but sixty per cent of the township is easily cleared as compared with most bush and this area is quite evenly distributed. The remainder of the township is rather heavily timbered with spruce and poplar up to eight inches in diameter. On sections 1, 2, 31 and 32 there is some good spruce timber. This, however, would be of no use as a timber limit but would serve the needs of the settlers in the immediate vicinity. There is no hay worth mentioning but the upland feed for stock is fairly good and good water is found in the various small streams. There are no stone quarries nor minerals of economic value. There is no game of any account.—*R. H. Knight, D.L.S., 1907.*

61. The best route for reaching this township from Edmonton is by way of the old Klondike wagon trail as far as the crossing of Paddle river in township 59, range 3; thence by a wagon trail in a northeasterly direction through this township and townships 59 and 60, range 2, entering township 61, range 2 in section 4. The surface of this township is gently rolling or nearly level, and the surface soil is composed of a rich black loam, averaging about six inches in depth. If once cleared of the bush it would be quite suited for mixed farming. There is no prairie and section 4 contains all of the light scrub within the township. There is a good quality of heavy spruce timber to be found on the following sections, 6, 7, 8, 17, 18, 19, the north half of section 5, the south half of section 20, the west half of sections 9, 16, 27, and the east half of section 28. The remainder of the township is mostly covered with poplar up to eight inches in diameter and in many places with young spruce of the same age. Sections 11, 12, 13 and 14 are largely covered with windfall of young poplar. There is no hay to be found, but good water can be secured from the small creeks, swamps or muskegs, but none of these are numerous. An abundance of good wood furnishes the chief supply of fuel. Coal is likely to be found near the surface but does not outcrop. There are no stone quarries nor minerals of economic value. The only game consists of moose and bear, both of which are plentiful.—*R. H. Knight, D.L.S. 1907.*

Range 3.

5. The westerly part of this township is reached only by pack trail, which I cut from an old logging camp in section 1, township 5, range 4. Wagon trails run across the southern portion and to about the centre of the township where oil wells are being sunk. It is covered with timber, but the northern portion almost to the north boundary of section 19 has been burned over, and most of the timber is dead. However

Range 3—Continued.

there still stands a goodly quantity of spruce and pine, along the west boundary. It is extremely mountainous along the line and is cut by numerous small mountain streams. The soil is chiefly a clay loam. No waterfalls, minerals, or stone quarries are located in this part of the township. No coal was seen. Black bear were encountered here on a few occasions.—*W. H. Young, D.L.S., 1908.*

5. The soil in the valleys of this township consists of black loam with clay subsoil and on the hills and mountains clay and gravel occur. The valleys and low hills are very rich and capable of producing large crops of hay, oats and hardy vegetables. Cattle and horses will do well owing to the large growth of grass and abundant water supply. There are also large tracts of land, heavily wooded, which I believe have already been sold to lumbermen. Petroleum is also present and several companies are operating in the valley of Southfork river. The valleys are fairly level, in some places rolling, but the township generally is rough, hilly and mountainous. Hay can be cut wherever open and level prairie ground can be found, but there are no extensive tracts of hay lands. The water supply consists of the finest of fresh water, and the supply in all the streams is permanent as they are fed by springs from the hills and mountains. Southfork river is the largest stream, running northerly throughout the entire length of townships 4, 5 and part of township 6, range 3. It is fed by large tributaries from the east, west and south coming from the mountains and it drains a very extensive tract of country. Its width averages from fifty to one hundred feet and the depth from two to twenty feet. The volume of water is very large and the current runs at rates varying from four to ten miles an hour, according to the height of the water, which is highest about the month of June and lowest about February. During extremely high water the lowest lands along the Southfork are liable to be flooded, but this is not likely to occur often. A dam could be constructed in this stream at some point where the river is narrow and the banks high, of which there are many good places, and probably five hundred horse-power could be developed. The altitudes vary from 4,700 to 7,900 feet. The rain and snow fall is very great in this region, this year particularly. The most lasting storms, accompanied by the greatest precipitation came from the northeast, and the thunder showers of short duration from the west and southwest. There are a few summer frosts, but no doubt with the opening of the country these will no longer occur. Coal is to be found underlying the conglomerate rock which outcrops in many places along Southfork river. There is also large quantities of wood consisting of pine, spruce and fir. There are no stone quarries. The minerals consist of those already mentioned, coal and petroleum, neither of which has yet been developed. Placer gold has been found on Gladson creek, but not in large quantities. There are a number of fur bearing animals to be found, such as beaver, marten, foxes, mink, weasels, bears, coyotes and lynx. There are also a few deer, sheep, goats and elk. Trout is plentiful in all the streams.—*W. F. O'Hara, D.L.S., 1907.*

6. The trail to this township lies through township 6, range 2, leaving the Pincher creek to Frank trail at the correction line on the north boundary of section 32, township 6, range 2. A very good trail lies in a southwesterly direction, crossing the fords on Southfork river. This trail may be followed to the westerly boundary of the township. Another trail, when the ford is impassable, runs over high hills and through creeks to avoid cut banks and joins the above mentioned trail in section 15. The whole township is very mountainous. Only in small patches is the land arable. Much of the township was burned over some years ago, and what timber there was has died. Small poplar and some jackpine are found in patches. On the south side of the river, in sections 6 and 7, some dead timber, fourteen inches to eighteen inches in diameter,

still stands. Both coal and wood for fuel are found in abundance. In sections 8, 9 and 10 veins of coal are being opened up. There are no stone quarries or minerals of economic value. In section 14 is a small hay meadow. Water in abundance is obtained in Southfork river, and its tributaries supply a great quantity of trout. Waterfalls and swift rapids in every section through which it passes might be used for water-powers. Some red deer and grouse and an occasional bob-cat and black bear were seen in the township. During the spring months, and until nearly August 1, Southfork river is a roaring torrent. It is on an average four chains wide and four to five feet deep. The stream is confined to very well defined banks, but overflows the low lying land at high water. Summer frosts are common almost every month, although excellent vegetables are grown in sections 24 and 25.—*W. H. Young, D.L.S., 1908.*

8. A wagon road leading from Frank to Lille and a lumber trail branching off to the north immediately west of Lille enabled us to survey the lines that were needed in the western portion of this township. A trail branching off to the north from the main trail between Lundbreck and Frank, following along the east boundary of townships 7 and 8, was followed into that part of township 8 east of the Livingstone range of mountains. That part of the township to the west of Livingstone range is rough and mountainous, with the exception of the valley where the mining village of Lille is situated in section 18. The soil consists of clay. Hay in small quantities is cut from the land around Lille. Creeks afford a fresh and permanent supply of water, Caudon creek and Gold creek being the two largest ones, they being from three to six feet wide and from one to three feet deep. There are no water-powers. Wood and coal are easily available for fuel. The timber consists of spruce, balsam, pine and poplar. Some small lumbering operations were being carried on in sections 30 and 19. Coyotes, grouse and partridge were the only kind of game seen. The part of the township to the east of the range is hilly and much more open, with clumps of poplar and willow brush. It is more suitable for cattle ranching than for agricultural pursuits. The climate is subject to summer frosts. The rock formation is usually slate capped with limestone or limestone only.—*T. A. Davies, D.L.S., 1908.*

9. The soil in this township is a black loam with a clay subsoil, and in places clay. Sections 14, 23, 25, 26 and 35 are rolling, with clumps of poplar and willow brush. Parts of these sections would be suitable for agriculture. A large portion of section 26 is marshy, and section 25 is mostly hilly. The country is more suitable for cattle ranching than for any other occupation. Hay grows throughout sections 14, 23, 25, 26 and 35. It had been cut and staked by three men who had settled there. Two main creeks give a fresh and permanent supply of water. They average from three to five feet in width, from six inches to two feet in depth and flow approximately two miles per hour. There are no water-powers. Summer frosts occur. Snow fell during September and October to a depth of two feet on the level. Wood is easily available for fuel on the slopes of Livingstone range. No stone quarries nor minerals were located. Deer, coyotes, grouse and partridge were seen, also abundance of trout.—*T. A. Davies, D.L.S., 1908.*

10. The eastern portion of the township where the survey was located is hilly and for the most part covered with spruce, balsam, fir, pine, poplar and willow brush. Fir, balsam and spruce, from one to two and one-half feet in diameter, are situated in section 23 and the north half of section 14. Hay grows in sufficient quantities for grazing only. The water supplied by the creek, is fresh and permanent. They average four feet wide, one foot deep and a current from two to three miles per hour. There are

Range 3—Continued.

no water-powers. The climate is subject to summer frosts. Snow fell in September and October to a depth of two feet. This disappeared within a week. Wood is readily available for fuel. There are no stone quarries or minerals of economic value. Deer, coyotes, grouse and partridge were the only game seen. No settlers have located in this township where the survey was made.—*T. A. Davies, D.L.S., 1908.*

12. (North outline). The township was very hilly and some of the hills showed an elevation of nearly 8,000 feet by our barometer. There is not much timber of any commercial value along this line.—*James Warren, D.L.S., 1908.*

12 and **13.** A good wagon trail following the north fork of Oldman river, and connecting with trails leading to Pincher creek and Cowley, was our route into these townships. The soil as seen in the few places where pits could be dug was either clay or a clay loam, usually mixed with gravel and rock. The surface of the country is rough and mountainous, timbered with spruce, balsam and pine, averaging from three to eighteen inches in diameter, also poplar, alder and willow brush. On the north and east slopes the ground is usually covered with windfall. The open parts lie along the summits of the ridges and for a short distance down the hillsides. Hay grows throughout the valleys, though not in sufficient quantity or quality for cutting, yet it affords grazing for horses and cattle. A small amount of hay is cut and stacked in the valley of Livingstone river. The water of the creeks is fresh and gives a sufficient and permanent supply. They are, with the exception of Livingstone river, from two to ten feet wide, one to three feet deep and flow from one to four miles per hour. Any falls or rapids occurring are small and unimportant. The winters are severe with the temperature frequently at thirty and forty degrees below zero. Snow falls during some winters to a depth of three or four feet. Some years the fall is not sufficient for sleighs. Summer frosts occur frequently. Wood is the most easily obtained fuel, although coal seams were seen in section 21, township 13 and section 29, township 12. The rock formation is slate and limestone. There are no stone quarries nor indications of any mineral of economic value. Game consists of deer, lynx, bear, coyotes and a few marten, grouse, partridge and ptarmigan.—*T. A. Davies, D.L.S. 1908.*

61. The best route by which to reach this township from Edmonton is by the old Klondike wagon trail as far as section 19, township 60, range 3, thence by a poorly constructed wagon trail northeasterly which enters this township in section 4. The surface of this township is gently rolling, and the surface soil is composed of black loam, averaging about five inches deep, with a subsoil of clay, if once cleared of bush it would be well suited for mixed farming. There is no prairie, and sections 3 and 4 contain all the light scrub in the township. There is a large quantity of first class spruce and tamarack timber on sections 1, 2, 10, 11, 12, 13 and 14. The remaining sections are covered with poplar up to eight inches in diameter, accompanied in many places by young spruce of the same age. There are muskegs adjacent to Shoal lake, on the north. Sections 30, 31, the west halves of sections 29 and 32 are practically all muskeg. These muskegs are nearly always covered with young spruce or tamarack up to six inches in diameter. The only hay found is that growing about the shore of the lake. There are large quantities here, but the ground is generally rough and wet, which would make the cutting of the hay difficult. The water of Shoal lake is good, also that of Shoal creek, which runs through the township in a northeasterly direction from the lake. The chief source of fuel is the abundance of good wood. Coal is likely to be found near the surface, but does not outcrop. There are no stone quarries nor minerals of economic value. Game in this township is limited to moose and bear, of which traces were frequently seen.—*R. H. Knight, D.L.S., 1907.*

Range 4.

8. The soil in this township consists of clay. The country is not suitable for agricultural purposes as the surface is very rough and mountainous, especially in the northern part, and covered with spruce, fir, balsam, pine and poplar, averaging from 6 to 30 inches in diameter. The sidehills are in many parts covered with windfall. Water is fresh and the supply permanent. There are no water-powers. Frosts occur frequently throughout the summer. Wood and coal are both available for fuel. Coyotes, grouse, partridge and trout were seen.—*T. A. Davies, D.L.S., 1908.*

12. The country through which this line runs is very rough. Only a small portion of it would be fit for ranching or any other economic purpose. We did not find any trace of any mineral along this line, as the country was so rough and rocky. There are a few fine streams on which good water-powers could be developed, but they are so far away that they would not be of any value at present. The timber is also small and of no commercial value.—*James Warren, D.L.S., 1908.*

12. (North outline.) This township was very hilly, and some of the hills showed an elevation of nearly 8,000 feet by our barometer. There is not much timber of any commercial value along this line. Livingstone river, a tributary of Oldman river, crossed the line in section 36. This is a fine stream, on which a very powerful water-power could be developed. All the other streams are small.—*James Warren, D.L.S., 1908.*

45. A wagon trail from Bluff Centre postoffice to Buck lake runs through the northerly part of the township and though in the spring almost impassable, it is at other seasons frequently travelled. Spruce muskegs with jackpine and poplar ridges comprise nearly the whole of the township, the soil on the ridges being generally clay covered in the northwest portion with six inches of black loam. The country is generally rough and broken, the township being a watershed from which Blindman river and its west branch, and a number of tributaries of Modeste creek have their sources. Timber suitable for settlers' purposes only is found throughout nearly the whole township consisting of jackpine, poplar and spruce to ten inches in diameter. There are no large hay sloughs but good pasturage is found on the ridges. Creeks are numerous and the water is of fine quality. Blindman river rising in the west and flowing easterly through the middle of the township is twelve feet wide and two feet deep when passing through section 13. The west branch of Blindman river, rising in the southwest, is only two feet wide and six inches deep when flowing south through section 4. Neither river admits of water-power development. The climate is similar to that of Edmonton and summer frosts are liable to occur. No indications of coal were found but plenty of timber for fuel is available. No stone quarries or minerals were located. Game, which is very scarce, consists of moose, bear, deer, prairie-chicken and partridge.—*H. L. Seymour, D.L.S., 1908.*

46. The wagon trail from Bluff Centre postoffice to Buck lake just enters the southwest corner of the township and from this a wagon trail, fairly passable in dry weather, has been cut northerly following along Modeste creek and joins in the south of township 47 a wagon trail leading to Wetaskiwin. To the south the township is generally quite heavily timbered, poplar, spruce and balsam to fifteen inches in diameter being found in roughly rolling country. The middle of the township is more open, being covered with small poplar and willow and is fairly level; this portion is suitable for homesteading, especially section 12. To the north the township is very heavily timbered with spruce, jackpine, balsam, tamarack and poplar, and the country is very roughly rolling. Timber berth No. 1,306 occupies the northeast corner of this township and has spruce to twenty-six inches in diameter with large poplar and some

Range 4—Continued.

birch. The soil is generally clay with very little top soil. No hay meadows of any size exists, but in the middle of the township good pasturage will generally be found. The main branch of Modeste creek rises in the north of township 45 and when entering this township in section 6 is four feet wide and one foot deep. In section 34 this stream is forty feet wide and from two to three feet deep, being joined in this section by a tributary from the east, which, rising in township 45 enters section 1 two feet wide and six inches deep and is nearly as large as the main branch before the point of confluence. In the north of the township the banks of both these branches are often over fifty feet in height. Many small creeks are tributary to the two main streams and the quality of the water in this township is excellent. The climate is similar to that of Edmonton. Small veins of lignite probably occur along the banks of Modeste creek, but plenty of fuel consisting of dry and green timber is available. No stone quarries or minerals were located. Game, which is very scarce, consists of moose, bear and deer.—*H. L. Seymour, D.L.S., 1908.*

61. The only route by which to reach this township from Edmonton is along the old Klondike wagon trail which enters the township in section 3. The surface is nearly level or gently rolling, and the surface soil where muskegs are absent is composed of a black loam, about five inches deep, with a subsoil of clay, which if once cleared of bush would be quite suited for mixed farming. There is no prairie, and sections 3, 4 and 5 contain all the lighter scrub within the township. There is good spruce timber found on parts of sections 1, 2, 3, 5, 6, 23, 24, 25 and 26, but in no case is a section completely covered with good timber. A thick growth of young poplar and spruce, up to six inches in diameter, with an undergrowth of willow, extends over sections 19, 27, 28, 29 and 30. A large muskeg extends across the township from section 18 to Shoal lake in section 13. The muskeg varies in width from one to two and one-half miles and comprises about 5,000 acres. It is absolutely impassable by horses except when frozen. Another muskeg extends from section 31 easterly across the township and terminates in range 3. This latter muskeg extends over sections 32, 33, 34, 35, 36, parts of 25 and 27 as well as a large area north of this township, the extent of which is not yet known. Shoal lake which has an area of about 2,000 acres in township 61, range 4, extends over parts of sections 1, 2, 12, 13 and 14. The water of this lake is good and large quantities of hay grow along its shore, but the saving of this hay would be difficult owing to the rough bottom and the low lying wet shore. The chief source of fuel is the abundance of good wood. Coal is likely to be found near the surface but does not outcrop. There are no stone quarries nor minerals of economic value. The climate is fair, but owing to the low lying muskegs the higher lands might be subject to slight summer frosts. Game in this township is limited to moose, of which traces are frequently seen.—*R. H. Knight, D.L.S., 1907.*

Range 5.

22. This township was reached by travelling southwesterly along a trail passing north of Priddis. The trail is very wet and difficult to travel on, especially in the spring. The soil is generally light and loamy, especially on the hills, and in places it is quite sandy and would not be suitable for farming. There are some localities that would be suitable for ranching and there are also some good hay meadows. The surface is generally scrubby or covered with small pine and poplar but none of any commercial value. The water is good, no alkali being seen or noticed in any of the streams. Elbow river crosses a portion of sections 34 and 33. This is a strong and heavy stream, but has no available water-powers. The stream is apt to rise very high and would be destructive to any dam that would be built. Timber could be rafted down the river

Range 5—Continued.

in ordinary water. The climate seems favourable and there are no indications of summer frosts. There are no quarries, though in some places fixed rock comes to the surface. No minerals of any kind were seen. Wood fuel is quite plentiful. The surface is very hilly and rough, there being very little low or flat land in the township except on parts of sections 26 and 27.—*James Warren, D.L.S., 1908.*

23. This township was reached by trail from township 22. The soil in this township is generally light, but in some places there is good clay. The surface is covered with bluffs of spruce, poplar and jackpine, scarcely any of which is of any commercial value, as most of the large timber has been cut. The soil and general features would be more adapted for ranching than for general farming, which does not appear to have been tried by any of the people who had settled on parts of this township. There does not appear to be any hay land or meadows. The water is good; the streams and creeks are all fresh with no trace of alkali. The climate seems to be good but there would likely be danger of summer frosts. There is plenty of wood fuel but no indications of coal, stone or other minerals are to be seen. No game of any kind is to be seen anywhere. The general indications show that part of the township might be used for ranching purposes, as there appears to be plenty of feed and good water.—*James Warren, D.L.S., 1908.*

45. The wagon trail from Bluff Centre postoffice to Buck lake runs in a westerly direction about a mile north of this township from which an old pack trail branching southeasterly into the township enters in section 33. The soil, a clay subsoil generally covered with black loam from two to eight inches in depth, is in parts suitable for agricultural purposes. The surface of the country is, however, quite rough and broken, covered with spruce, poplar and jackpine to ten inches in diameter suitable for settlers' purposes, except to the north, where the country is more open with windfall and willow scrub, and the northwest sections are probably the most desirable for settlement. There are no large hay meadows, but good pasturage can be found in most of the sections. Water is of fine quality, and the creeks are numerous. The main tributary of Buck lake (Mink creek) has its source in the southeast corner of the township and leaves in section 19, being there ten feet wide and one foot deep with a valley from fifty to one hundred feet and up to half a mile wide. Two smaller creeks, also tributary to Buck lake, leave the township in sections 32 and 33, respectively. The climate is similar to that of Edmonton. No indications of coal were found in this township, but plenty of timber for fuel is available. No stone quarries or minerals were located. Game consists of moose, bear, deer and partridge.—*H. L. Seymour, D.L.S., 1908.*

46. The wagon trail from Bluff Centre postoffice to Buck lake runs westerly through the southerly sections of the township and reaches Buck lake in section 7. In section 5 a wagon trail leading to the mouth of Brazeau river, on the Saskatchewan, branches from the Buck lake trail. Throughout the township a number of old Indian pack trails lead easterly and northerly from Buck lake. The township is fairly level timbered to the north with poplar and spruce to fifteen inches in diameter and some jackpine, balsam and birch. The westerly portion of section 19 is occupied by timber berth No. 970, where spruce up to twenty inches in diameter with good-sized poplar, balsam and birch is found. Timber berth No. 962 probably occupies most of section 31, spruce to fifteen inches in diameter being found there. The southerly portion of the township is more open, with spruce and tamarack muskeg and dry and green patches of spruce, poplar and jackpine with willow brush. The majority of the sections are suitable for settlement the soil generally being four inches of black loam with clay subsoil. No large hay meadows were noted. Buck

Range 5—Continued.

lake occupies parts of sections 6, 7, 30 and 31. There are a number of small creeks tributary to this lake, the quality of the water being excellent. Muskrat creek, six feet wide, one foot deep, enters the township in section 4 and Buck lake in section 7. The development of water-power in this township is impracticable. The climate is similar to that of Edmonton. Plenty of dry and green fuel for timber is available, but no coal, minerals or stone quarries were located. Tracks of moose and deer were noted and in Buck lake whitefish and jackfish are found.—*H. L. Seymour, D.L.S., 1908.*

53. The only possible way of reaching this township is by pack trail in the summer months from Lake St. Ann settlement or Entwistle. By using sleighs in the winter, a very good road has been opened up which to a great extent follows the lakes, rivers and sloughs. As it is possible to take a heavy load the whole distance, it is found that this is the most economical way of taking supplies into this country. From the report furnished the Department by Mr. Ross, D.L.S., in connection with the survey of the thirteenth base line, I expected to be able to use wagons as far as Chip lake, but this I found to be impracticable, at least in the earlier part of the season owing to continuous wet weather, and the abnormal traffic over it of teams employed in the construction of the Grand Trunk Pacific railway. Although the contractors, Messrs. Foley Brothers and Stewart, were continually improving and changing this road especially the portion south of Chip lake, it was impossible for a team to take anything more than an empty wagon over it. There are two pack trails as far as the 'Big eddy,' on McLeod river; one is known as 'Jock's' trail and the other the 'Jasper' trail. Both these trails cross the Pembina at the old crossing, or the 'Jasper crossing,' but the former turns north of Chip lake as far as township 56 and thence in a southwesterly direction to the 'Big eddy.' The latter trail, however, runs almost due west, passing south of Chip lake and is by far the shorter trail. I found, however, that the first mentioned trail was the more suitable, although two days longer, owing to its being fairly dry in rainy weather, also on account of an abundance of feed for horses at all seasons. I found the 'Jasper' trail very bad and almost impassable owing to a great extent to its crossing a large number of wide and soft muskegs, long and continuous stretches of fallen timber and also to the unsatisfactory condition of bridges. From the 'Big eddy' the trail follows along McLeod river. I used this trail in the survey of this township as far as 'The Leavings,' but from that point I found it necessary to open a new trail about eight miles north and east to the centre of the township. From Lake St. Ann settlement, with a load, it took thirteen days to reach the camp and three weeks for a round trip. The soil, generally speaking, throughout this township is not of the very best, in fact the greater portion of it is of an inferior quality. The higher ground has evidently been subjected to a succession of very severe fires, which have burnt off all the top soil or loam and baked the clay subsoil to such an extent that I found it very difficult to excavate for pits. The clay in most cases is of the boulder variety, which would make it very difficult to cultivate. There are large areas of muskegs, however, which, if drained, would make very desirable land. The townships, on the whole, would be suitable for grazing, and here and there sufficient land could be found for mixed farming where the surface is not too rough. The township, as a whole, might be described as being covered with scrub, with patches of timber and thick small jackpine. The timber is found in the muskeg areas which lie to the north of the lakes in sections 7 and 8, and practically extending east and west across the whole township. There is also a belt of timber in the northwesterly portion of the township. The timber in this township is principally spruce, although a little tamarack and jackpine is to be found. The spruce would average about twelve inches in

Range 5—Continued.

diameter and the other timbers somewhat smaller. None of the timber areas are of sufficient size or quantity to be of any great commercial value, and should be reserved for the benefit of the settler. There are no hay sloughs or marshes of any extent in this township, the only hay which is found is a narrow strip usually around lakes and sloughs. The ground is usually of so marshy a nature that hay can only be cut with a scythe. The water in the vicinity is of the very best and free from alkali. The chain of lakes and spring creek which run to the northwest into Athabaska river might be mentioned, as they abound in trout and other fish. The climate is similar to that of the Edmonton district, but is probably subject to earlier frosts, also to excessive hail storms which follow the valley of the McLeod and Athabaska rivers. The fuel at present which can be most readily procured would be wood, but there is an unlimited supply of coal in the valley of McLeod river within a comparatively short distance.—*A. E. Farncomb, D.L.S., 1908.*

61. The only route by which to reach this township from Edmonton is along the old Klondike wagon trail, which enters the township in section 12. The surface is quite varied. The southerly two tiers of sections are somewhat level and contain a considerable amount of muskeg; the next two tiers are quite rough and broken, while the northern portion is cut up by Athabaska river, its valley and the numerous adjacent ravines. The soil is good, generally consisting of four to six inches of black loam with a clay subsoil. The township is wooded throughout by either muskeg timber, upland spruce timber or the ordinary upland growth of poplar, up to six inches in diameter, with underbrush of willow and hazel. Sections 1, 2, 3, 4, 5, 6, 11 and 12 contain most of the muskeg land. Sections 3, 4, 5, 6 and that portion of the township lying north of the Athabaska contain most of the best quality of large spruce timber, while the remainder of the township consists of land covered by poplar with undergrowth of willow and hazel. There is no hay of any extent within the township, but there is good water everywhere. Wood fuel is abundant. Coal is likely to be found comparatively close to the surface, but does not outcrop. There are no stone quarries nor minerals of economic value. The climate is good, but slight summer frosts may occur owing to the dense growth of bush and the large muskegs in township 61, range 4. There is no game of any account.—*R. H. Knight, D.L.S., 1907.*

Range 6.

45. A wagon trail from Buck lake to the Saskatchewan opposite the mouth of Brazeau river runs in a westerly direction about half a mile north of this township and though but a new trail is quite passable; it is occasionally travelled in dry weather and makes a good winter trail. Over half of the township to the south and west is heavily timbered, comprising timber berth No. 1243, spruce up to thirty-six inches in diameter and good sized poplar and jackpine being found. The northerly portion is more open, with spruce and tamarack muskegs, and hay sloughs with some brulé and windfall. The northeasterly portion is quite rough and covered with dead standing and fallen timber. The soil is generally sandy or clay, but in the timber is covered with black loam up to six inches. There is good hay land in sections 29 and 30 consisting of a large slough with some windfall and willow brush. Creeks are numerous and the water of good quality. Mink creek runs through the northeast part of the township and when crossing the north outline in section 32 is eighteen feet wide and two and one-half feet deep, being joined in section 26 by a tributary from the south, twelve feet wide, one and one-half feet deep, but neither of these creeks will admit of development of water-power. The climate is similar to that of Edmonton. No indications of coal were

Range 6—Continued.

discovered but plenty of fuel consisting of green and dry timber is available. No stone quarries or minerals were located. Game, which is very scarce, consists of moose, bear, deer, ducks and partridge.—*H. L. Seymour, D.L.S., 1908.*

46. The wagon trail from Buck lake to the Saskatchewan opposite the mouth of Brazeau river runs in a westerly direction across the southerly part of the township. It is quite passable in dry weather and makes a good winter trail. The southwesterly part of the township is quite rolling, lightly timbered with poplar and willow brush, with some spruce muskegs. Buck lake, five miles long, from two to three miles wide and about twenty feet deep, occupies most of the easterly portion of the township, but timber berth No. 970 extends into section 24 and timber berth No. 962 probably occupies a portion of sections 35 and 36; in both these limits spruce from fifteen to eighteen inches in diameter is found. Two to three miles northwest from Buck lake, good timber consisting of spruce, tamarack and balsam, up to eighteen inches in diameter, is found. Timber berth No. 963 enters section 33, where spruce and poplar from six to eighteen inches in diameter grows along the west side of Buck lake near the middle of the township; spruce and poplar up to eighteen inches in diameter might be suitable for a small timber berth. Along the west side of Buck lake, to the north, the country is quite level and fairly open, with brulé and willow scrub. The soil is generally a few inches black loam with clay subsoil. To the southwest of Buck lake around lakes Nos. 1 and 2 good slough grass is found making good winter grazing for stock. Other small hay meadows are found around the lake. Mink creek entering this township in section 2 is twenty-five feet wide and four feet deep; it flows into lake No. 2 and then into Buck lake. Other small creeks with excellent water run into Buck lake but Washout creek, five feet wide and two feet deep, flows westerly from this township in section 7 towards Wolf creek. The climate is similar to that of Edmonton. No indications of coal were discovered but plenty of fuel consisting of dry and green timber is available. No stone quarries or minerals were located. Game, which is very scarce, consists of moose, deer, bear, ducks and partridge, and in Buck lake, whitefish and jackfish abound.—*H. L. Seymour D.L.S., 1908.*

61. This township is reached by the old Klondike trail to Holmes Crossing post-office, thence via pack trail. The trail is nearly impassable during most of the summer season for anything but light wagons or pack horses. The soil is generally sandy and fit for some mixed farming when cleared, all south of the river being timbered with jackpine and spruce averaging sixteen inches in diameter, and poplar eight inches in places. The north side of the river is poplar averaging four inches. There is no hay, but there is plenty of good water in Athabaska river and the creeks and marshes. The Athabaska averages fifteen chains in width, six feet deep and has a current of three to four miles an hour. There is no danger of flooding and no available water-powers. Summer frosts were observed but did little damage. Wood is plentiful but no coal or other economic mineral was observed. There are no stone quarries. Moose, caribou and bear signs were plentiful. All the township south of Athabaska river is timbered sufficiently for reservation as a timber limit.—*C. C. Fairchild, D.L.S., 1908.*

62. This township is reached by the Chalmer's or Klondike trail which is good in winter but almost impassable in summer. The soil is generally good, suitable for farming except where swampy. The surface is all timbered, except sections 1, 2 and 3, where there is some open country near the site of old Fort Assiniboine. There is some timber of value along Freemen river and in section 1 on Athabaska river. The latter is in timber berth No. 1397. The timber is spruce, averaging eighteen inches in diameter but outside the limit there is not enough to reserve in any one place.

Range 6—Continued.

There is a little hay on the open flats but all is embraced in the squatters' holdings. There is plenty of good water in Freemen and Athabaska rivers. Freemen river will average two chains in width and two feet deep and has a current two to three miles an hour. There is little danger of flooding in this township. There is no available water-power. Summer frosts did no damage this season. Wood is the only fuel seen. No coal or other economic minerals were found and there are no stone quarries. Some moose, caribou, jumping deer and bear tracks were seen. There are about twelve squatters in this township, and a considerable area of land suitable for settlement can be found in the other parts of the township. The great drawback is the difficulty of transportation. The settlers are all enthusiastic as to the climate, soil, &c., but feel the need of improved transportation facilities.—*C. C. Fairchild, D.L.S., 1908.*

Range 7.

49. This township is reached by a good wagon road leading from the Tomahawk settlement through township 50 and entering this township in section 36, following the west bank of the Saskatchewan to section 4. Two roads branch off this trail heading west, one in section 36 and the other in section 16. The northeast portion of this township is fairly open, rolling land, being an old brulé overgrown with small poplar and willow. The soil is good and suitable for farming. Some heavy spruce and poplar occur on the south side of the Saskatchewan, also in sections 16, 17, 21, 20, 29 and 30. These areas have been taken as timber limits. The balance of the township is covered with windfall and burnt timber with thick growth of poplar and willow brush. Except in the heavy timber, where a greater depth of soil is found, the soil is mostly clay, with in places a few inches of black soil. It is suitable for agricultural purposes. The country is well watered by several large creeks emptying into the Saskatchewan. This river runs through the easterly part of the township. Some rapids, known as Rocky rapids, are located in this township. The fall is not very great, being only noticeable at low water, and has no value as a water-power. Hay is scarce. Wood for fuel can be found in every quarter section. There are no minerals, water-powers, stone quarries or coal in this township. The climate is similar to that of Edmonton. Game consists of moose, deer, coyotes, foxes and partridges.—*M. Kimpe, D.L.S., 1908.*

50. A wagon road from Tomahawk settlement enters this township in section 24 and running south leaves it in section 1. A trail to Pembina river branches off in section 14. The former is fairly good but the latter can be used only in winter. The easterly third of the township is rolling land, fairly open, with scattered poplar and underbrush. The soil is good and fit for agricultural purposes. In sections 11, 15, 16, 21 and 22 some heavy timber occurs, being spruce and poplar to eighteen inches in diameter. This area is included in a timber limit. The balance of the township is covered with poplar and cottonwood from six to fourteen inches in diameter. The soil is good, being on an average four inches of black loam on a clay subsoil. It would be suitable for farming after clearing the timber. This township is well watered by some large creeks, emptying into Saskatchewan river. Hay is scarce, occurring only along the water-courses. There are no minerals, stone quarries, coal or water-powers in this township. The climate is similar to that of Edmonton. Game consists of moose, deer, foxes, coyotes and partridge.—*M. Kimpe, D.L.S., 1908.*

51. This township is reached by a good wagon road leading from the Tomahawk settlement to Saskatchewan river, in township 49. A winter road branches off from the above road near the south boundary of section 1 and runs in a northwesterly direction across this township to Entwistle on the Grand Trunk Pacific railway. This township

Range 7—Continued.

is heavily wooded with poplar and cottonwood up to sixteen inches in diameter. Spruce and tamarack are found in the muskegs, along with a few scattered spruce among the poplar bush. This timber is suitable for building purposes, but at present has no commercial value. The soil consists on an average of four inches of black loam on a clay or sandy clay subsoil. If the country were cleared of the timber it would be fit for agricultural purposes; it is well watered by several large creeks running southeast and emptying into the Saskatchewan. The water is abundant and of good quality. Wood for fuel can be found on every quarter section. Hay is scarce and found only in small patches along the water-courses. There are no minerals, water-powers, stone in place or coal in this township. The climate is similar to that of Edmonton. Game consists of moose, deer, coyotes, prairie-chickens and partridge.—*M. Kimpe, D.L.S., 1908.*

52. This township is reached by way of Stonyplain and Entwistle. The road was almost impassable last summer so that transportation was exceedingly difficult. The soil is chiefly clay. The surface is thickly timbered with poplar, cottonwood and spruce. Poplar is the only timber of value, there being a large quantity suitable for pulp making. There are no extensive hay areas. Several small streams of fresh water are found. Pembina river runs through this township. Its current is rapid but there are no falls. Summer frosts were experienced every month. There is an abundance of wood for fuel, but no stone quarries or minerals of economic value were observed. Moose, deer, bear and beaver are to be found; the latter have been numerous but are now nearly extinct.—*Geo. Edwards, D.L.S., 1908.*

57. This township is reached from Lake St. Ann settlement, by a wagon road, which passes through it, leading to the mouth of McLeod river. This road, owing to having been but recently opened, is in places rather rough for heavy loads, but as a certain amount is spent every year on grading and improvements, it will soon be a good graded road. The soil in this township consists, in general, of a layer of black loam of variable depth resting on a clay subsoil and may be rated second and third class. The surface of the area contained between the south half of sections 13 and 18 and the north boundary of the township is for the most part undulating. It is in general open prairie with here and there clumps of brush and willow scrub, and the remainder of the township is of a rolling nature and thickly covered over with poplar and spruce from six to eight inches in diameter. In the north half of this township numerous hay meadows, of more or less extent, are to be found, but in some of these the hay is rather coarse and of poor quality. On the other hand, the 'upland' hay crop gathered along the course of Paddle and Little Paddle rivers, owing to its excellent qualities, can always be disposed of at a remunerative price. Paddle and Little Paddle rivers join in this township on the east boundary of section 22. The first-mentioned stream has an average width of twenty-five links, a depth of two feet and a current of one mile per hour; while the latter is fifty links wide, three feet deep with an average current of two miles. Owing to these two streams meandering through this township, a permanent supply of good water is assured to this locality. As above stated, the southern part of this township is densely timbered and a sufficient supply of fuel and lumber can be obtained therefrom. No water-powers, minerals of economic value, nor stone of any description were noted throughout the course of the survey.—*Louis E. Fontaine, D.L.S., 1908.*

61. This township was reached by the old Chalmer or Klondike trail to Holmes Crossing postoffice, and thence by pack trail along the south side of Athabaska river. The soil is generally sandy and when cleared would be suitable for mixed farming.

Range 7—Continued.

The whole township south of the river is heavily timbered with occasional muskegs and swamps, but on the north side the timber is not so heavy. Spruce and jackpine prevail on the south side, with a belt of spruce on the north side extending back half a mile and back of this poplar and cottonwood are found. Nearly all the timber south of the river will average sixteen inches and the belt north of the river eighteen inches in diameter. The poplar runs from four to sixteen inches, averaging about eight inches. There is no hay. Plenty of water is supplied by Athabaska river and the creeks, swamps, &c. Athabaska river averages fifteen chains in width, ten feet deep and has a current of three miles an hour. There is little danger of flooding and no available water-powers. Summer frosts were noticed but little damage was done. Wood is plentiful but no coal, lignite or other economic minerals were noted. There are no stone quarries. Moose, caribou, bear and grouse abound in the district. The greater part of this township south of Athabaska river is suitable for a timber berth.—*C. C. Fairchild, D.L.S., 1908.*

62. This township is reached by the old Chalmer or Klondike trail to Fort Assiniboine and thence a trail to McLeod lake passes through the southern portion of the township. This trail is passable, but in a wet season is very soft and muddy. The surface is timbered but the only timber of any value is along Freemen river in sections 24, 25, 26, 27, 34 and 35, where there is some fine spruce as large as thirty inches in diameter. The remainder of the township is covered with poplar, willow and spruce with some muskeg. The soil is suitable for mixed farming and except where timbered it is generally first class. Freemen river, Goose creek and a couple of lakes and swamps provide ample good water. There is little danger of flooding, and no water-power is available. Freemen river at low water is about two chains wide and averages three feet deep, with a current of three miles an hour. Summer frosts are rather prevalent in the swampy parts. There are no hay lands. No coal, lignite or other economic minerals were found. There are no stone quarries. Jumping deer and moose tracks were seen, also signs of bear were observed.—*C. C. Fairchild, D.L.S., 1908.*

Range 8.

40. (North outline.) In this township the surface is chiefly gently rolling land covered with jackpine, spruce and small poplar; the westerly part is dotted with small muskegs. The soil is of fair quality, consisting of sandy clay and some loam. —*B. J. Saunders, D.L.S., 1908.*

52. This township is accessible by the road from Stonyplain to Entwistle. Owing to the heavy traffic over this road last summer in connection with freighting supplies for the Grand Trunk Pacific contractors, the road was nearly impassable. The soil is chiefly clay, and if cleared would doubtless be well suited for general agricultural purposes, but being heavily timbered, it would be quite undesirable for settlement under present conditions. The timber is chiefly poplar with some cottonwood and spruce, with dense growth of underbrush or scrub in most places. The poplar is sound and would no doubt make excellent pulpwood. There are no extensive hay areas. Several creeks, all with one exception, affording good fresh water, are found, but there are no water-powers. Frosts are prevalent in summer. The abundant timber affords fuel but there are no stone quarries nor minerals of economic value. Traces of moose, deer, bear and beaver were seen. The beaver were very numerous here formerly but have all disappeared except in one pond in section 1. The northwest quarter of the township is very swampy.—*Geo. Edwards, D.L.S., 1908.*

Range 8—Continued.

58. The road from Belvedere to McLeod river passes through this township, also a trail connecting the above to the lake St. Ann and Sturgeon lake trail. Both are very bad in wet seasons. The number of squatters in this township, nearly fifty, proves the good quality of the soil. The eastern half of the township is rolling land covered with small poplar and willow, with some fallen timber. Sections 4, 10, 16, 17 and 8 are covered with green and burnt spruce, poplar and cottonwood of large size. The western portion is more level land, with a dense growth of poplar and spruce muskegs. Timber berth No. 1192 encroaches on this township from the north. Good slough and upland hay can be found throughout this township. Fresh water is supplied by creeks and springs almost anywhere. There are no large streams, waterpowers, minerals or stone quarries. The climate is similar to that of Edmonton. No summer frosts were recorded. Partridges, grouse, prairie-chickens and some foxes and coyotes were the only game noticed.—*M. Kimpe, D.L.S., 1907.*

Range 9.

40. (North outline.) This township is chiefly gently rolling land covered with jackpine, spruce and poplar up to thirty-six inches in diameter, and the westerly part is dotted with small muskegs and tamarack swamps. The soil is of a very fair quality, consisting of sandy clay and black loam.—*B. J. Saunders, D.L.S., 1908.*

Ranges 9 and 10.

44. The Buck lake trail leads from Rimbey and other parts of the settlement to Saskatchewan river, and sleighs may be used on it, but more improvements will be required before wagons could be used the whole distance. A sleigh trail was cut by the writer from the intersection of the twelfth base line with the Buck lake trail and follows the base line. This trail is a very good one for winter use, but should be avoided during the summer. The soil is sandy loam, clay and vegetable mould. Sections 36, 35 and 34, in range 9, are largely composed of muskeg, with jackpine ridges from four to six feet above the general surface. From this point to the crossing of Little Brazeau river, in section 33, township 44, range 10, the soil is somewhat better and the land higher, and when cleared would raise good grass, and might be suitable for cattle or horses. The timber across sections 36, 35 and 34, range 9, is generally quite small and scattered spruce and tamarack in muskegs and small jackpine on the ridges. From the centre of range 9 to Little Brazeau river lies an area of very fine timber consisting of spruce, jackpine, tamarack, with some poplar and cottonwood. The timber runs from six to thirty inches in diameter and lies in sections 33, 32 and 31, range 9. No hay was noticed in these ranges, except a small amount along the Little Brazeau. The water is all fresh, and the supply, as furnished by the Saskatchewan and Little Brazeau, is sufficient and permanent. The Little Brazeau is one and a half to two and a half chains wide, from six inches to two and a half feet deep, with a current apparently very rapid, probably four to five miles per hour. Land along the banks is not liable to be flooded. There are no falls, but rapids are numerous, and higher up the stream could be readily dammed to develop power. The climate is said to be similar to other portions of northern Alberta, and there are occasional summer frosts. Wood is the fuel most readily available, and can be procured almost any place in these ranges from the standing dry timber, which is abundant. No coal or lignite veins were noticed. Neither stone quarries nor minerals of economic value were seen in these townships. Game was apparently very scarce, as very few tracks of either ungulata or carnivora were noticed, but fish are said to abound in Little Brazeau river.—*A. H. Hawkins, D.L.S., 1908.*

Range 9.

52. A road from Stonyplain via Entwistle and thence westward across Pembina river, runs within three miles of the northern boundary of this township. Owing to the heavy traffic the road was almost impassable this season. The soil is clay, covered in most places by moss or vegetable mould. Over one-half of the surface is swamp alternating with jackpine ridges. There is a heavy growth of timber, but very little of any commercial value. There are no extensive hay areas, except a few strips of good grass along a creek. Several creeks afford a supply of good fresh water but there are no water-powers. Frosts are prevalent in summer. There is abundant wood for fuel, but no stone quarries nor minerals of economic value are found. Traces of bear and moose were frequently seen. This township is very undesirable for settlement as there is scarcely any good land.—*Geo. Edwards, D.L.S., 1908.*

55. A pack trail from Lake St. Ann settlement to McLeod river, commonly called 'Jock's' trail, passes about two miles south of this township. From this trail, near the east boundary of section 27, township 54, another pack trail runs north to the north boundary of township 55. It is in good condition. The surface of this township is gently rolling and covered by a thick growth of poplar, spruce and jackpine. The timber is suitable for building purposes, but has no commercial value. The soil is mostly two to three inches of black loam and clay subsoil. On account of the timber this township is not fit for agricultural or ranching purposes. Hay is scarce; water is plentiful and of good quality. No minerals, stone quarries or coal were noticed. There are no large streams and no water-powers. Game consists of moose, bear and grouse. The climate is similar to that of Edmonton. No summer frosts were noticed. —*M. Kimpe, D.L.S., 1908.*

56. A pack trail leaving Jock's trail near the east boundary of section 37, township 54, range 9 and running through the centre of township 55, gives access to this township. Except in a few low spots this trail is in good condition. The soil consists of black loam, to a depth of two to six inches, and clay subsoil. It is suitable for farming. The surface is rolling, covered with old brulé grown up with scrubby willow and poplar with patches of heavy timber. The timber is poplar, spruce and tamarack scattered through the township. Upland hay of good quality is abundant but there are no hay meadows. Water is furnished by Paddle river and several large creeks. It is of good quality and the supply is permanent. Paddle river averages about fifty feet in width with a depth of about three feet at low water. In time of high water there must be from six to ten feet of water, although the land adjoining the river has never been flooded. No water-power is available. The climate is similar to that of Edmonton. Wood fuel is available on every quarter section. No stone quarries, coal or minerals were noticed. Moose, bear and grouse are the only game in the vicinity.—*M. Kimpe, D.L.S., 1908.*

57. A road leaving the lake St. Ann to Sturgeon lake road in township 57, range 8 runs through sections 36, 25, 26 and 24. This road has been open for only a short time and is almost impassable. The surface is rolling and covered with small willow, poplar, spruce and fallen timber. The northern portion is more densely wooded while sections 12 and 13 are covered with large spruce. The soil is mostly sandy clay, the black loam having been burned off by bush fires. It produces, however, a good growth of grass and peavine. Some hay sloughs are located in sections 33 and 34. Several small creeks run through the township, emptying into Little Paddle river. Water is good and abundant. There are no water-powers, coal, minerals or stone quarries. Wood, dry and green can be found on every section. The climate is similar to that of Edmonton. No summer frosts were recorded. Game consists of deer, bear, grouse and coyotes.—*M. Kimpe, D.L.S., 1907.*

Range 9—Continued.

57 and **58**. (East outlines.) The country covered by these outlines is rather hilly. The luxuriant growth of grass and peavine together with the sheltered condition of the country will make this a good ranching district. The soil is a clay subsoil with, in places, a good depth of black loam, although on the hills and ridges the top soil has been burned off. Numerous creeks and springs afford a good supply of fresh water. The country is in general covered with poplar and willow brush with patches of fairly good timber. No coal, minerals or water-powers were noticed. Hay is plentiful and of good quality. The climate is similar to that of Edmonton. No summer frosts were recorded. Game consists of moose, deer, bear, wolves and grouse.—*M. Kimpe, D.L.S., 1907.*

58. The lake St. Ann to Sturgeon lake road runs through the southern part and the winter trail from Belvedere to McLeod river through the northern part of this township. The surface is rolling except in the northeast corner of the township which is covered with a level muskeg covering about six sections. Outside this muskeg the soil is generally a black loam with clay subsoil well adapted for farming. The land bordering on Little Paddle river is fairly open with patches of poplar and willow. On the south side of the river the timber is larger and some good building timber was seen. Little Paddle river and Bull creek furnish a good supply of fresh water. There is plenty of slough and upland hay of good quality. No water-powers, minerals, stone quarries or coal were found. The climate is similar to that of Edmonton. Game consists of moose, bear, deer, grouse and coyotes.—*M. Kimpe, D.L.S., 1907.*

59 and **60**. (East outlines.) The country covered by these outlines lies north of Athabaska river and in general is rough and hilly covered with green timber and windfall. The soil is sandy clay, covered with black loam and moss. The country is valuable only for lumbering purposes, the best timber being along Eagle creek and Christmas creek. The proximity of the Athabaska will make lumbering operations easy as soon as an outlet is obtained for the lumber. No water-powers or minerals were found. Sandstone of commercial value and coal have been seen on the Athabaska and on Eagle creek. The climate is similar to that of Edmonton. Game consists of moose, deer, bear, wolves and grouse.—*M. Kimpe, D.L.S., 1907.*

Range 10.

40. (North outline.) This township consists chiefly of rolling land covered with jackpine, spruce and poplar suitable for building purposes, and is broken by the south branch of Baptiste river and several large tamarack swamps. The soil is of good quality consisting of clay and loam with some sandstone outcroppings.—*B. J. Saunders, D.L.S., 1908.*

44. (See report for township 44, range 9, west of the fifth meridian.)—*A. H. Hawkins, D.L.S., 1908.*

52. (East outline.) This line is almost all swamp, crossed at intervals by jackpine ridges. There is no timber of any value, and the land is unfit for agricultural purposes.—*Geo. Edwards, D.L.S., 1908.*

55. The pack trail known as 'Jock's' trail, runs through the southerly portion of the township, making it easily accessible except during the spring months. The surface of the township is rolling, the soil generally consisting of from two to ten inches of black or vegetable loam, underlain by a subsoil varying from clay to sandy clay, gravel being found in but few places. With the exception of the northern central portions the township is heavily wooded, poplar and pitch-pine being found throughout,

Range 10—Continued.

while in sections 29, 30, 31 and 24, considerable spruce up to twenty-eight inches in diameter, and of excellent quality, is found. Sections 4, 9, 36, 20 and 29 are largely tamarack and spruce swamp. These swamps, acting as reservoirs, furnish a supply of clear, fresh water for a number of small creeks. In a dry season the water supply would, in all probability, fail. Upland grass is found throughout the township but in no place is this abundant. There are no hay sloughs. No minerals, stone in place or water-powers were found. The township generally is suitable for agriculture. Although traces of bear and deer were noticed, duck, grouse and lynx were the only game seen. —*M. Kimpe, D.L.S., 1908.*

56. The township is easily reached by pack animals either from 'Jock's' trail which runs through the southerly portion of township 55, range 10 or from Sturgeon trail on the north. The surface throughout is rolling, the soil generally consisting of from two to ten inches of black loam, underlain by a subsoil varying from clay to sandy clay. Very little gravel occurs and the soil throughout is suitable for agriculture. The township is in general heavily wooded with poplar, and in the lower lands along Paddle river with spruce and tamarack, spruce up to twenty-four inches in diameter being occasionally found. The sections along the base line are covered with willow and poplar scrub. Upland grass, peavine and vetch occur throughout the township, there being excellent grass in sections 28, 29 and 30. The township is drained by Paddle river which with its branches and tributaries gives a permanent supply of clear fresh water. No stone in place, minerals or water-powers were found. The climate resembles that of Edmonton district. Bear, deer, partridge, duck and prairie-chicken were the only game noticed.—*M. Kimpe, D.L.S., 1908.*

57. We reached this township by travelling from Edmonton to Lake St. Ann settlement and thence following a road leading in a northwesterly direction to Greencourt postoffice, situated on section 16, township 8, range 9. The distance from Lake St. Ann to Greencourt is considered to be about fifty-five miles and for forty miles the road is only a trail in a deplorable condition through a difficult country. The mail travels from Edmonton to Greencourt by way of Riviere-qui-barre and McDonald's crossing at the Pembina. Then from there it goes westerly through Peavine prairie until it reaches Greencourt which is said to be sixty miles from McDonald's crossing. The soil in this township is a thin coat of black loam over a clay subsoil. Stones, gravel and sand are frequently met with. In spite of this, it appears to be quite suitable for farming purposes. The surface is heavy rolling and hilly. In the northwest and southwest sections it is nearly mountainous. The slope is mostly to the south. Poplar from five to nine inches in diameter in fair quantities is met with in the northern part of the township. Spruce is found in small muskegs in most of the sections. The largest areas of spruce are in the swamps on the north boundary of section 9 and on the east boundaries of sections 3 and 10. There may be enough wood to supply the first wants of the settlers and furnish fuel for two or three years, but there is no merchantable timber of any extent in the township. Outside of the areas of fairly large spruce and poplar already spoken of the country is covered with a growth of small poplar and brush with, in places, small patches of scrubby prairie. In most of the sections there is enough easily cleared ground to make a good farm in a few years. Hay sloughs are small but prairie is found in every section. With the exception of the lake on the north boundary of section 24 the only supply of water comes from the numerous rivulets which cross the township. The water is good everywhere. There are no water-powers, stone quarries nor minerals in the country. The climate is about the same as that of Edmonton. Game is scarce; we saw only a few partridge, a few rabbits and geese in the lake in section 24.—*Geo. P. Roy, D.L.S., 1908.*

Range 10—Continued.

57 and **58**. (East outlines.) The country covered by these outlines is rather hilly. The luxuriant growth of grass and peavine together with the sheltered condition of the country will make this a good ranching district. Some good farming land can be found in this range where the surface is more gently rolling. The soil is a clay subsoil with, in places, a good depth of black loam although on the hills and ridges the top soil has been burned off. Numerous creeks and springs afford a good supply of fresh water. The country is in general covered with poplar and willow brush with patches of fairly good timber. No coal, minerals or water-powers were noticed. Hay is plentiful and of good quality. The climate is similar to that of Edmonton. No summer frosts were recorded. Game consists of moose, deer, bear, wolves and grouse.—*M. Kimpe, D.L.S., 1907.*

58. The lake St. Ann and Sturgeon lake road touches this township near its northeast corner. A trail was cut from the above trail in section 3, township 59, south to the south boundary of this township, but, being a winter trail, it would be impassable in the summer. The surface is hilly and covered with poplar and willow. Spruce occurs along the creeks, which are numerous, running into Little Paddle river and Bull creek. The soil is mostly sandy clay the black loam having been burned off. There are several small hay sloughs and in places upland hay could be cut. The country would be better adapted to ranching than farming. No water-powers, minerals, coal or stone quarries were noticed. The climate is similar to that of Edmonton. No summer frosts were reported. Game consists of moose, deer, bear, wolves and grouse.—*M. Kimpe, D.L.S., 1907.*

59. The lake St. Ann and Sturgeon lake road cuts this township from section 1 to section 19. It is a fairly good trail better adapted to pack horses than wagons on account of the hilly nature of the country. A muskeg encroaches on this township from the east, rendering sections 24, 13, 12, 14 and 23 useless at present. The rest of the township is covered with timber more dense along Athabaska river where large spruce trees were noticed. Toward the southern part of it, the timber gets lighter with more windfall. The soil is a sandy clay covered with black loam where the bush fires have not burned it off. Some sections along the trail would be adapted for agricultural purposes. Several springs furnish a good supply of fresh water. Hay is not plentiful the best being in sections 1 and 2 already taken by squatters. No water-powers, minerals, coal or stone quarries were noticed. The climate is similar to that of Edmonton. No summer frosts were reported. Game consists of moose, deer, bear, wolves and grouse.—*M. Kimpe, D.L.S., 1907.*

59 and **60**. (East outlines.) The country covered by these outlines lies north of Athabaska river, and in general is rough and hilly, covered with green timber and windfall. The soil is sandy clay, covered with black loam and moss. This country is valuable only for lumbering purposes, the best timber being along Eagle creek and Christmas creek. The proximity of the Athabaska will make lumbering operations easy as soon as an outlet is obtained for the lumber. No water-powers or minerals were found. Sandstone of commercial value and coal have been seen on the Athabaska and on Eagle creek. The climate is similar to that of Edmonton. Game consists of moose, deer, bear, wolves and grouse.—*M. Kimpe, D.L.S., 1907.*

Range 11.

40. (North outline.) This township consists chiefly of heavy rolling land, covered with fallen timber, and is well wooded with jackpine, spruce and poplar suitable for

Range 11—Continued.

building purposes. There are also outcroppings of coal in section 6, township 41. The soil is of a fairly good quality, consisting of loam with clay subsoil.—*B. J. Saunders. D.L.S., 1908.*

Ranges 11 and 12.

44. The best route for reaching these townships is probably to follow the Buck lake trail to where it is crossed by the twelfth base line and thence by following the trail cut in running the line. This trail is quite easy to follow in winter with sleighs, but should be avoided in summer and one of the pack trails leading from Rocky Mountain House used. The soil is a sandy loam and gravel on the ridges and black loam with a clay subsoil in the muskegs, and would have to be cleared to be cultivated. Some places along the Brazeau and Little Brazeau would doubtless, if cleared, produce good hay, coarse grains, potatoes and vegetables. The surface is rolling and all timbered with small trees four to twelve inches in diameter, of little value for lumbering, but sufficient for buildings for settlers and for fuel. A small amount of hay might be cut along the Little Brazeau and where the line cuts it. The water is all fresh and the supply abundant and permanent. The Little Brazeau is one and one-half to two and one-half chains wide, six inches to two and one-half feet deep, with a current apparently very rapid, probably four to five miles per hour. Land along the banks is not flooded; there are no falls or rapids, but the stream could be dammed and power developed higher up. Brazeau river, three to twenty chains wide, six inches to six feet deep, has a current of three to five miles per hour, and in places divided into numerous channels. The valley had numerous bars, which are flooded at high water from two to five feet deep. The climate is probably similar to the settled portions of northern Alberta, but is subjected to occasional summer frosts. Wood is the most easily available fuel, of which there is an abundance to be procured at any place in these townships. Some drift coal was noticed on Brazeau river, but no veins in place were seen. No stone quarries and no minerals of economic value were noticed. Game is not plentiful, a few fresh elk tracks were seen, and occasionally a fox or wolf track; signs of bear were numerous, and a few grouse were seen. There is said to be an abundance of trout in both rivers.—*A. H. Hawkins, D.L.S., 1907.*

Range 11.

54. The northern part of this township is quite inaccessible by pack animals during the summer months. A winter trail crosses section 36. The country is gently rolling, consisting of spruce and tamarack swamps, the few ridges which occur being covered with windfall. This portion of the township is quite unsuitable for agriculture. Poison creek, a stream twenty-five feet wide and five feet deep, runs through section 36, emptying into Chip lake. Muskrats, mink, geese and duck were noticed around Chip lake. The climate is similar to that of Edmonton. No water-power, coal, stone or minerals were noticed.—*M. Kimpe, D.L.S., 1908.*

55. The pack trail from lake St. Ann settlement to McLeod river, known as 'Jock's' trail, runs in a westerly direction through the centre of the township. A winter trail enters the township in section 1 and leaves it in section 19. The township is thus easily accessible, except during the spring months. The northern half of the township is sharply divided from the southern by a ridge which runs westerly through the centre of the township. The northern portion is heavily rolling and covered with poplar generally, the ridges being covered with willow and poplar scrub, while spruce and tamarack are found in the lower valleys. The soil in this portion consists of from

Range 11—Continued.

two to four inches vegetable loam underlain by clay or sandy clay, stones and boulders being found on all the ridges. The southern portion consists of tamarack and spruce swamps, with an occasional ridge of poplar and jackpine. In sections 4, 5, 6 and 7 considerable spruce, up to thirty inches diameter and of an excellent quality, is found. Fuel is, of course, abundant. The township is not well adapted to agriculture. The creeks and small lakes which are found in the southern portion of the township drain into Poison creek, a stream twenty-five feet wide and about six feet deep where it leaves the township in section 1. Water is excellent and abundant. Grass grows throughout the township, but no hay sloughs were found. No minerals, stone in place, coal or water-powers were found. Duck, partridge, chicken, muskrats and jackfish were the only game noticed, these latter being found in the small lake in sections 8 and 9.—*M. Kimpe, D.L.S., 1908.*

56. The township is most easily reached from the pack trail known as 'Jock's' trail from Lake St. Ann settlement to McLeod river, which runs through the centre of the township to the south. With the exception of the spring months, this trail is in good condition through the year, there being a winter road for sleighs. The surface of the township is heavily rolling, the soil consisting of sandy clay, with gravel and stones on all the uplands. The western half of the township is covered with poplar and willow scrub, while the eastern portion is heavily wooded with poplar, birch, jackpine and spruce, tamarack being found in the lower lying lands. Small hay sloughs occur in sections 29 and 27, but upland grass is fairly abundant throughout the western portion of the township. Clear, fresh water is furnished by a number of small creeks, but this supply in a dry season would in all probability fail. These creeks eventually drain into Paddle river. The climate resembles that of the Edmonton district, but frosts occur very early. Fuel is abundant. No minerals, stone in place or coal were found. Grouse are plentiful, and one moose was seen, these being the only game noticed.—*M. Kimpe, D.L.S., 1908.*

57. To reach this township we came through St. Albert and Lake St. Ann settlement to Greencourt by a road running northwest for nearly sixty miles, forty of which is only a wood trail, muddy, hilly and crooked, ascending steep inclines, sliding down vales, winding through woods and wading muskegs, rivers and creeks. The heaviest grades are at the approaches of the Pembina and at a small creek about ten miles east of Greencourt. Another road, which the mail follows, runs by way of Prince Albert, Rivière-qui-barre and McDonald's crossing at the Pembina and from there westerly by Raydale to Greencourt. This trail is reputed to be more difficult to travel and longer than the other. The topography of the country may be given as a succession of hills with easy slopes, except in the north part of the township, where the hills are steep and difficult of access. The soil underlaid by clay, sandy clay or clay and gravel, is a layer of black loam, four to eight inches deep in the more open places. In the bush it is a top dressing of vegetable mould and black loam in the sloughs, and a growth of moss in the spruce swamps. It is certainly well adapted for farming, and quite suitable for the growing of vegetables and roots of the hardier kind. The surface is rough and broken, especially in the northern part. It is covered with small poplar and willow brush, patches of bare prairie alternating with bluffs of larger poplar and some spruce muskegs. There is no merchantable timber to any extent. A good fire would denude the country completely. The spruce muskegs should be preserved for the preservation of the water supply, as they appear to be the headwaters of quite a number of creeks some of which flow to Paddle river and others to McLeod river. Hay sloughs are scarce, but there is, all through the township, a growth of peavine which would

Range 11—Continued.

supply quite a quantity of upland hay. The water is good wherever found. There being no large streams there are no available water-powers. The climate is moderate, as far as I could judge. I am told that there were light summer frosts, but not severe enough to harm the crops. Wood is the only fuel readily available, and nearly every section contains enough for a few years. We noticed outcroppings of stone and boulders in some places, but there are no stone quarries, nor any minerals of economic value of any kind. We saw tracks of moose, deer and bear. Partridge and chicken and a few rabbits were the only game seen.—*Geo. P. Roy, D.L.S., 1908.*

57 and **58.** (East outlines.) The country covered by these outlines is rather hilly. The luxuriant growth of grass and peavine, together with the sheltered condition of the country, will make this a good ranching district. Some good farming land can be found in this range, where the surface is more gently rolling. The soil is a clay subsoil with, in places, a good depth of black loam, although on the hills and ridges the top soil has been burned off. Numerous creeks and springs afford a good supply of fresh water. The country is in general covered with poplar and willow brush, with patches of fairly good timber. No coal, minerals or water-powers were noticed. Hay is plentiful and of good quality. The climate is similar to that of Edmonton. No summer frosts were recorded. Game consists of moose, deer, bear, wolves and grouse.—*M. Kimpe, D.L.S., 1907.*

59. The lake St. Ann and Sturgeon lake pack trail crosses the northern portion of this township and is fairly good. The surface is rough and hilly, covered with heavy timber on the north half and fallen timber and scrub on the south half. Several large creeks run through this township, the most important being Beaver and Mink creeks. The 'flats' along the Athabaska might be fit for agricultural purposes, although covered in places by fallen timber. Hay is scarce and of poor quality, being found only in muskegs. Good sized spruce were seen along the Athabaska, but not in sufficient quantity to be of any commercial value. No water-powers, minerals, stone quarries or coal were noticed. The climate is similar to that of Edmonton. Game consists of moose, deer, bear, wolves and grouse.—*M. Kimpe, D.L.S., 1907.*

59 and **60.** (East outlines.) The country covered by these outlines lies north of Athabaska river, and in general is rough and hilly, covered with green timber and windfall. The soil is sandy clay, covered with black loam and moss. This country is valuable only for lumbering purposes, the best timber being along Eagle creek and Christmas creek. The proximity of the Athabaska will make lumbering operations easy as soon as an outlet is obtained for the lumber. No water-powers or minerals were found. Sandstone of commercial value and coal have been seen on the Athabaska and on Eagle creek. The climate is similar to that of Edmonton. Game consists of moose, deer, bear, wolves and grouse.—*M. Kimpe, D.L.S., 1907.*

Range 12.

44. (See report for township 44, range 11, west of the fifth meridian.)—*A. H. Hawkins, D.L.S., 1907.*

40. (North outline.) This township consists chiefly of rolling burnt land, covered with jackpine, spruce and poplar suitable for building purposes, and there is a great deal of fallen timber. The soil is of fair quality, consisting chiefly of loam, with clay subsoil, and clay and coarse gravel.—*B. J. Saunders, D.L.S., 1908.*

54. This township can be reached during the winter from the Grand Trunk Pacific railway, the line being four miles south. Windfall and swamps would make it very difficult for heavy loads during the summer. The country generally is low and wet,

Range 12—Continued.

the few small ridges being covered with excessively bad windfall. Spruce and tamarack, with occasional jackpine ridges, are found throughout, but have little commercial value. The soil is quite unsuitable for agriculture, and practically no grass or hay is found. Although there are no creeks, the country is drained by Little Lobstock river, a stream averaging one chain wide and five feet deep. Along this creek traces of mink and marten are plentiful, but partridge and muskrats were the only game seen. —*R. V. Heathcott, D.L.S., 1908.*

55. The trail known as 'Jock's trail' runs in a westerly direction through the northerly portion of the township. Except during the spring months, when the trail becomes rather wet, the township is easily reached from Lake St. Ann settlement or Entwistle, a station on the Grand Trunk Pacific railway, by means of pack animals, while during the winter sleighs can be used, the trail being cut wide enough for that purpose. The surface of the township is gently rolling and is heavily wooded, the northern third having poplar and spruce, while the southern portion is heavily covered with spruce, tamarack and jackpine. With the exception of clumps of heavy spruce along the southern boundary, none of the timber is of much value. In sections 1, 4 and 5, however, considerable spruce of a good quality is to be found. The soil on the uplands consists of from two to six inches of black loam underlain by sand or sandy clay, with boulders in many places. In the lower lying portion the usual growth of moss underlain by black muck is found. The township is quite unsuitable for agriculture at present. Several small lakes are found in the southern portion of the township giving a permanent supply of clear, fresh water, which drains by way of Poison creek into Chip lake; the northwest corner of the township, however, drains into McLeod river. Upland grass is luxuriant, and a small quantity of hay could be cut around the lake lying along the north boundary of section 9. Fuel is abundant. No minerals, water-powers or stone in place were found. The climate resembles that of the McLeod river district, being slightly more extreme than that of Edmonton. No game except chicken, partridge and muskrats was seen.—*R. V. Heathcott, 1908.*

56. This township is easily reached from the trail known as 'Jock's trail,' which runs in a westerly direction through the northern portion; it is cut wide enough for sleighs, and as a pack trail is in good condition, except during early spring. The surface is heavily rolling, the soil consisting of sandy clay or clay, with from two to eight inches of vegetable loam on the surface. The eastern two-thirds of the township is in general covered with willow and poplar scrub, spruce and tamarack being found in the lower depressions. In the western portion considerable spruce, poplar and birch of good size and fair quality is found, the under brush being very heavy. Jackpine ridges occur along the western limit, but the timber is of very little or no value. The western portion of the township is unsuitable for agricultural purposes, but the eastern portion is very good and quite suitable. No hay sloughs of any size were found, though upland grass is abundant. There is plenty of water of excellent quality, several small creeks furnishing a permanent supply. There are no water-powers. No minerals, coal or stone quarries were found. Grouse and deer are the only game. The climate is the same as that of Edmonton.—*R. V. Heathcott, D.L.S., 1908.*

57 and **58**. (East outlines.) The country covered by these outlines is rather hilly, especially where the lines pass over House mountain, the summit of which is about five hundred feet above McLeod river. The luxuriant growth of grass and peavine, together with the sheltered condition of the country, will make this a good ranching district. The soil is a clay subsoil with, in places, a good depth of black loam,

Range 12—Continued.

although on the hills and ridges the top soil has been burned off. Numerous creeks and springs afford a good supply of fresh water. The country is in general covered with poplar and willow brush, with patches of fairly good timber, this range being heavily wooded with poplar and spruce of good merchantable value. No coal, minerals or water-powers were noticed. Hay is plentiful and of good quality. The climate is similar to that of Edmonton. No summer frosts were recorded. Game consists of moose, deer, bear, wolves and grouse.—*M. Kimpe, D.L.S, 1907.*

59. The lake St. Ann and Sturgeon lake pack trail enters this township in section 36; another pack trail from the west connects with the above on this section. The surface of this township is hilly and broken by ravines. Some of the flats along McLeod river are level and fit for agricultural purposes. The northern slope of House mountain, a high ridge situated mostly south of this township, is covered with fallen timber and a dense growth of small poplar and jackpine. There is, along the Athabaska and McLeod rivers, a small fringe of spruce fit for lumbering or building purposes. The soil of the northern portion of this township is a sandy clay covered by black loam to a depth of two to four inches, while the soil of the southern portion of the township is only sand and gravel. Good hay can be found along the McLeod. This river averages about seven chains in width, with from four to fifteen feet of water and a current of five miles an hour at low water. The Athabaska is a much larger river and very swift. There are no water-power sites on the Athabaska or McLeod. A seam of coal outcrops on the north bank of the McLeod and the south bank of the Athabaska, and would indicate a bed of coal in sections 21, 28, 29, 32 and 33. No minerals or stone quarries were noticed. Water is fresh and abundant. There is a good supply of wood for fuel and building purposes. Game consists of moose, deer, bear, timber wolves and grouse. The climate is similar to that of Edmonton. No summer frosts were recorded.—*M. Kimpe, D.L.S., 1907.*

59 and 60. (East outlines.) The country covered by these outlines lies north of Athabaska river, and in general is rough and hilly, covered with green timber and windfall. The soil is sandy clay, covered with black loam and moss. This country is valuable only for lumbering purposes, the best timber being along Eagle creek and Christmas creek. The proximity of the Athabaska will make lumbering operations easy as soon as an outlet is obtained for the lumber. No water-powers or minerals were found. Sandstone of commercial value and coal have been seen on the Athabaska and on Eagle creek. The climate is similar to that of Edmonton. Game consists of moose, deer, bear, wolves and grouse.—*M. Kimpe, D.L.S., 1907.*

Range 13.

44. These townships are similar in character, and may therefore be classified with fallen timber and thick scrub, with scattered clumps of jackpine, spruce and balsam. The soil is of fair quality, consisting of loam with clay subsoil, and clay with sandstone outcroppings.—*B. J. Saunders, D.L.S., 1908.*

Ranges 13, 14, 15, 16.

44. These townships are all similar in character, and may therefore be classified together. They may be reached by following the trail leading from the Mountain House on Saskatchewan river to Brazeau river during summer, or in winter by following the sleigh trail cut when running the twelfth base line. The sleigh trail follows the river from the first crossing of the line in range 13. The soil on the uplands is

Ranges 13, 14, 15, 16—Continued.

sandy loam and gravel and in the muskegs vegetable mould, while in the river bottom large flats of silt or river sand were noticed. The soil on the uplands is apparently not very fertile, as very little grass was noticed. It is apparently too sandy, although in the valleys the growth appeared to be quite luxuriant. The surface is rolling, the larger proportion of these townships being muskegs, forming the head waters of many deep ravines and small creeks leading to the river, but the land seems to be poor and the timber small and scattered, except in the valley of the Brazeau, where there are some fine bunches of spruce. Hay in small quantities was noticed in several places along the valley, but not of much value on account of the windfall and flooding. The water is all fresh and abundant. Brazeau river, three to twenty chains wide and six inches to six feet deep, has a current of three to five miles per hour, and in places divides into numerous channels; the valley between the banks has numerous bars and is all liable to flooding from two to six feet. This fact is rather a deterrent to settlement upon any of the meadows, which are in many cases covered with windfall. The river, I think, would be difficult to drive on account of bars and swift current, as great jams of driftwood are to be seen along its banks, and the high water mark is clearly indicated on the standing timber. No water-powers were noticed in these townships. The climate is evidently similar to that of the other portions of northern Alberta lying contiguous to the mountains, and would be, I think, subject to occasional summer frosts. Wood is the most readily available fuel and is abundant on all sides. No stone quarries or minerals of economic value were noticed, although drift coal was seen along Brazeau river. A few tracks of deer and elk were observed, but game was apparently scarce, although trout, of which there are said to be several varieties, are plentiful in the Brazeau and its tributaries. I should like to draw attention to the tract of country comprising sections 32 and 31, township 44, range 16, and sections 4, 5 and 6, township 45, range 16, crossed by this line. These sections would, in the writer's opinion, form a very desirable holding for either horses or cattle. Some clearing would be required to get rid of the windfall, but with small improvement a very considerable tract of land could be easily reclaimed, and hay could be cut without clearing in several places in section 4 that are quite above the high water mark, while there is ample timber for building and fences, as well as fuel.—*A. H. Hawkins, D.L.S., 1908.*

Range 13.

54. This township is easily reached from the Grand Trunk Pacific railway, which runs through the southerly portion of the township. The surface is gently rolling, the eastern half consisting of level, wet tamarack and spruce swamps, with occasional ridges bearing small jackpine, while the western half is covered with small spruce, tamarack, jackpine and poplar, the windfall being excessively bad. None of the timber is of any value. The soil on the ridges consists of sand or a very light sandy clay, and is quite unsuitable for agriculture. There is practically no grass, and no hay sloughs were found. Several small creeks drain this township, the eastern half draining into Lobstick river, while the western half drains into McLeod river. No minerals, stone in place or water-powers were found, and game, with the exception of grouse, is very scarce.—*R. V. Heathcott, D.L.S., 1908.*

55. The trail known as Jock's trail runs through the northerly portion of this township. Except in the spring, this trail is in good condition for pack horses in summer and sleighs in winter. The trail runs either to Lake St. Ann settlement or Entwistle. The surface is gently rolling, and, with the exception of some clumps of fair spruce along McLeod river, is covered with small spruce, tamarack, jackpine and

Range 13—Continued.

poplar, most of which is firekilled. The soil of the uplands consists of clay, sandy clay or sand with boulders in places, and on the whole is hardly suitable for agricultural purposes. Although good soil is found on some of the flats, the southeastern portion of the township is wet, consisting of spruce and tamarack swamps, the small jackpine ridges being covered with windfall. While upland grass is abundant in the northern portion and on nearly all the flats along the river, very little hay could be cut. No minerals or coal were seen, although there are several outcrops of gray sandstone along the river. Excellent water is found all over the township. There are no water-powers. The climate is a little more severe than that of Edmonton. A few moose, grouse and rabbits were the only game seen.—*R. V. Heathcott, D.L.S., 1908.*

56. The Shiningbank lake trails are suitable for either pack horses in summer or sleighs in winter. The pack trail is in good condition, except in the early spring, the township is thus easily accessible during the summer, fall and winter from either lake St. Ann or Entwistle. The surface is rolling. The soil to the east of McLeod river, which flows through this township in a northerly direction, is chiefly sand, while west of the river it is sandy clay or clay, with a few inches of black loam on the surface. There are a few clumps of good spruce along the west side of the river, but the land lying east is covered with jackpine, spruce, tamarack and poplar of poor quality. The soil is hardly suitable for agriculture, except on the flats along the west bank of the McLeod. A few small hay sloughs occur in the eastern portion of the township, while in the western portion upland grass is abundant. Water of excellent quality is found everywhere. The creeks drain into McLeod river. Gold washing has been carried on in the river at different times. No coal was seen, but several sandstone exposures occur along the McLeod. There are no water-powers. The climate is practically the same as that of Edmonton. No game was seen, but there are plenty of fish in the river.—*R. V. Heathcott, D.L.S., 1908.*

57 and **58.** (East outlines.) The country covered by these outlines is rather hilly, especially where the lines pass over House mountain, the summit of which is about five hundred feet above McLeod river. The luxuriant growth of grass and peavine, together with the sheltered condition of the country, will make this a good ranching district. The soil is a clay subsoil with, in places, a good depth of black loam, although on the hills and ridges the top soil has been burned off. Numerous creeks and springs afford a good supply of fresh water. The country is in general covered with poplar and willow brush, with patches of fairly good timber, this range being heavily wooded with poplar and spruce of good merchantable value. No coal, minerals or water-powers were noticed. Hay is plentiful and of good quality. The climate is similar to that of Edmonton. No summer frosts were recorded. Game consists of moose, deer, bear, wolves and grouse.—*M. Kimpe, D.L.S., 1907.*

Range 14.

40. (North outlines.) This township consists chiefly of burnt rolling land covered with considerable fallen timber and scattered clumps of jackpine, spruce and poplar suitable for building purposes, and is much broken by Mire creek and an outlying spur of the Rocky mountains in the westerly sections. There are some outcroppings of limestone. The soil is of very fair quality, consisting of loam and clay.—*B. J. Saunders, D.L.S., 1908.*

44. (See report for township 44, range 13, west of the fifth meridian.)—*A. H. Hawkins, D.L.S., 1908.*

Range 14—Continued.

53. This township is reached by the Yellowhead pack trail, which runs through the southern part of it. The trail was in very poor condition. The soil is mostly black loam with clay subsoil. When cleared the country will be suitable for farming. The surface is covered with poplar and willow, but no timber nor hay is to be found. There is a small creek flowing through sections 30, 29, 28, 27, 26 and 25, but there is no water-power in the township. There were no frosts at the time of survey (July). There is plenty of dry poplar in this township, but no stone quarries nor minerals were found and no game was seen.—*J. C. Baker, D.L.S., 1908.*

55. I reached this township by Jock's trail, which runs near the south cross line, and is in good condition. The soil is black loam and clay subsoil, suitable for farming. The surface is covered with small poplar and willow, and in section 12, along McLeod river, there are some large spruce and tamarack, varying in size from six to twenty-four inches in diameter. There is plenty of hay land in sections 4, 9, 10, 11, 3 and 2. It is good quality, both lowland and upland. In May the weather was very wet and in September fine and clear. McLeod river, a fine fresh water stream, flows through the southern part of this township. There is no water-power. Plenty of dry poplar for fuel is to be found anywhere. No stone quarries, minerals or game were seen.—*J. C. Baker, D.L.S., 1908.*

56. I reached this township by a pack trail which follows the eastern boundary of townships 55 and 56, range 14. This trail was new, but was fairly good. The soil, which is black loam with clay subsoil, is suitable for farming. The surface is covered with small poplar and willow, too small for timber purposes. There is plenty of upland hay of good quality found principally in sections 32, 33, 34, 27, 26, 25, 22, 23, 14 and 24. There is an abundance of fresh water in this township. Shiningbank lake is a large body of fresh water comprising sections 27, 28, 29 and 30. Shiningbank creek flows easterly from the lake and empties into McLeod river. There are no water-powers. The weather was warm at the time of survey. Dry poplar for fuel can be found anywhere in the township. There are no stone quarries nor minerals. Some moose and bear were seen, and plenty of geese and duck on Shiningbank lake.—*J. C. Baker, D.L.S., 1908.*

Range 15.

40. (North outline.) The easterly part of this range is badly broken by an outlying spur of the Rocky mountains, which is about 2,000 feet high on each side of the gap through which the line passes. The slopes are covered with jackpine and small poplar. The westerly part of the township is more rolling and open. The soil is of fair quality, consisting of loam and clay, with limestone outcropping.—*B. J. Saunders, D.L.S., 1908.*

44. (See report for township 44, range 13, west of the fifth meridian.)—*A. H. Hawkins, D.L.S., 1908.*

52. This township is reached by the Yellowhead Pack trail which runs through the southern part of it. The trail was in very poor condition. The soil is nearly all black loam with clay subsoil. When cleared it will be suitable for farming. The surface is covered with poplar, willow and jackpine, but the wood is too small for timber purposes. There is no hay. In section 29 there is a fine fresh water lake and a smaller one in section 20. Wolf creek flows northerly through the western part. It is a fresh water stream varying in depth from two to six feet, but there is no water-power in the township. At the time of survey (August) there were no frosts. There

Range 15—Continued.

is plenty of dry poplar and tamarack, but no stone quarries nor minerals were found. No game was seen.—*J. C. Baker, D.L.S., 1908.*

53. This township is reached by the Yellowhead pack trail which runs through the southern part of it. The trail was in very poor condition. In this township the soil is nearly all black loam with clay subsoil. When cleared it will be suitable for farming. The surface is covered with poplar, willow and jackpine, but it is too small for timber purposes. There is no hay. In section 9 there is a fine fresh water lake and a smaller one in section 16. The creeks are all very small in this township. The weather was warm at the time of survey (July). There is plenty of dry poplar and tamarack for fuel. No water-powers, stone quarries nor minerals were found, and no game was seen.—*J. C. Baker, D.L.S., 1908.*

55. I reached this township by 'Jock's' trail, which passes through the southern part of the township. The trail was in fine condition. The soil is mostly sandy loam and suitable for farm purposes when cleared of its small poplar and willow. No timber of value nor any hay land was found. There are several fresh water lakes, but no water-powers. The climate is like that of northern Alberta generally, with frosts in September. There is plenty of dry poplar and tamarack for fuel. No stone quarries, mineral nor game were seen.—*J. C. Baker, D.L.S., 1908.*

Range 16.

40. (North outline.) In this township the land consists chiefly of hilly land covered with jackpine, spruce and balsam, six to twenty-four inches in diameter, and fallen timber. The soil is of fairly good quality, consisting of loam with clay subsoil. —*B. J. Saunders, D.L.S., 1908.*

44. (See report for township 44, range 13, west of the fifth meridian.)—*A. H. Hawkins, D.L.S., 1908.*

52. This township is reached by the Jasper or Yellowhead pack trail which passes through the northern part of the township, but it was in very poor condition. The soil, which is black loam with clay subsoil, will be suitable for farming when cleared of poplar, willow, spruce and tamarack, with which the surface is now covered. This is all too small for timber purposes. There are no hay meadows. Moose creek, a fine fresh water stream about two chains wide and varying in depth from one to six feet, flows northerly through the western part, but there is no water-power in the township. The weather was very warm at the time of the survey (August). There is plenty of dry spruce and tamarack for fuel, but no stone quarries nor minerals were found, and no game was seen during the survey.—*J. C. Baker, D.L.S., 1908.*

Range 17.

40. (North outline.) In this township there is very hilly country well timbered with jackpine, spruce and balsam, and covered with fallen timber. The westerly part of the township is broken by the Bighorn range of the Rocky mountains, and is barren and practically impassable. These mountains show an elevation of 8,225 feet above sea-level, which is approximately 2,000 feet above the water of the branch of Brazeau river. This stream breaks through the mountains in section 31, township 40. The soil consists of loam with subsoil of clay and stone, and limestone outcroppings. —*B. J. Saunders, D.L.S., 1908.*

TOWNSHIPS WEST OF THE FIFTH MERIDIAN.

Ranges 17, 18, 19.

44. These townships lie in the foothills, and being similar in all respects are classified together, and until easier and more speedy means of transport and better roads are established are not likely to be occupied. At present their only visitors are surveyors, prospectors or Indians. They may be reached by following the trail leading from the Mountain House, on Saskatchewan river, to the Brazeau river during summer, or in winter by following the sleigh trail cut when running the twelfth base line. The soil is sandy loam and gravel on the hills and ridges, and black loam in the valleys, and, if cleared of the windfall and brush, would doubtless raise a good crop of grass and possibly oats, but I think the elevation is rather too great for farming to any extent; cattle and horses would, however, do well in this locality. The surface is very rolling and broken, cut by numerous deep ravines leading to Brazeau river and several high rocky peaks. The timber is without commercial value, except in range 19, where a nice bunch was noticed extending for about two miles along the river and one-half to one mile on either side, and is chiefly spruce, six to twenty-four inches in diameter. In other localities there is generally sufficient for fuel or buildings required by settlers, but the whole surface of this country has been repeatedly burnt over. Hay meadows were noticed in some of the small valleys, but the windfall, dry timber and brush would have to be cleared before the hay could be cut. The water is all fresh and abundant and the supply is permanent. Brazeau river, flowing through a canyon throughout these ranges, is from one to six feet deep, two to four chains wide, with a current of three to four and a half miles per hour, and lands in the valley below the canyon are liable to flooding two to four feet deep. There are no falls, but many rapids and several good locations for damming were noticed, and especially about sections 33 and 34, range 19, where the canyon walls are rocky and precipitous. The climate is apparently similar to other places in northern Alberta, but is subject to summer frosts. Wood is the fuel most readily available, but drift coal was seen along the river, although no seams were observed. There are said to be several coal locations in this vicinity. No stone quarries or minerals of economic value were observed. Tracks of moose, elk and red deer were seen on several occasions. Many signs of bear were noticed, and trout, of which there were said to be several varieties, were apparently abundant in the river.—*A. H. Hawkins, D.L.S., 1908.*

Range 17.

52. This township was reached by the Jasper or Yellowhead pack trail, which was in very poor condition. The soil in the southern part is black loam and clay subsoil, suitable for farming. In the northern part, especially near McLeod river, it is sand, and may be only good for grazing. The surface is covered with small poplar, willow, spruce and tamarack. There is some spruce and tamarack large enough for timber in sections 3, 4, 5 and 6. It varies from eight to twenty-four inches in diameter. There are no hay meadows. McLeod river passes through the northern part of this township. The weather was very warm at the time of survey (August). There is plenty of dry tamarack and spruce for fuel but no stone quarries nor minerals are found, and no game was seen.—*J. C. Baker, D.L.S., 1908.*

Range 18

40. (North outline.) The easterly part of this township is verp mountainous and practically impassable. The westerly part is more rolling and well timbered with open stretches along the branch of Brazeau river, and gradually opens out into a broad plain leading to the northwest. The soil consists chiefly of clay, stone and coarse gravel, with some loam.—*B. J. Saunders, D.L.S., 1908.*

TOWNSHIPS WEST OF THE FIFTH MERIDIAN.

Range 18—Continued.

44. (See report for township 44, range 17, west of the fifth meridian.)—*A. H. Hawkins, D.L.S., 1908.*

Ranges 18 and 19.

48. Access to these townships is obtained by following the trail on the south bank of McLeod river from 'Big eddy' and follows the east bank of Embarras river. The surface is somewhat rolling, muskeg and sandy jackpine ridges; along the Embarras valley, which cuts the township in range 18, section 32, are some small meadows, to the north along the Embarras river are some very fine meadows bounded by a large amount of brulé and windfall timber, chiefly small spruce, jackpine, a few poplar, willow and tamarack. The soil is very sandy on ridges, with vegetable mould in the muskeg, and the clay and stone subsoil apparently not very fertile; grass is not luxuriant at any place along the line, except a few small patches on the rivers, but the soil would probably support a good vigorous growth of timber if cared for. The timber is poor, a small quantity along the river banks being composed of spruce and jackpine in sections 32 and 31, township 48, range 18. No hay of any account was found along the line, but a very fine meadow was noticed in township 51, range 19, at the junction of the east and west forks of Embarras river. Hay of good quality, composed of peavine and redtop, extends about two and a half miles along the river and from one-quarter to one-half mile in width, and much more could be taken in with small improvements. The water is all fresh and the supply abundant. Each branch of the Embarras is from one to one and a half chains wide, six inches to three feet deep, with a current of two to three and a half miles per hour; the land generally is not liable to flooding from the river. No water-powers are found in these townships. The country is said to be subject to summer frosts. The fuel most readily available is wood, an abundance of which may be had in any direction. No veins of coal or lignite were observed, nor stone quarries, nor minerals of economic value. Traces of moose, elk, bear, foxes and wolves were seen, but game appears to be rather scarce in this locality.—*A. H. Hawkins, D.L.S., 1907.*

Range 18.

52. There are no regularly used trails into this township; it can be reached from the trail to the Yellowhead pass, but, owing to the quantity of muskeg, it is hard to get into with horses in the summer time. The soil is chiefly sandy loam, with peat, clay and gravel subsoil, and, with the exception of sections 36, 33 and 21, where the soil is a good black loam with clay subsoil, is not suitable for agricultural purposes. The surface is rolling and covered with spruce, tamarack and jackpine up to eighteen inches in diameter. There is also poplar in places. The timber is suitable for lumbering. McLeod river runs right through the township. There are also a number of small creeks containing good water. There is good hay land on sections 36 and 33. The climate is the same as at Edmonton. There are no minerals, stone quarries or water-powers. Bear, moose, deer and partridge were seen. Fish are plentiful in McLeod river and the creeks.—*R. V. Heathcott, D.L.S., 1907.*

53. This township may be reached from Edmonton in the winter by a sleigh road which passes through Lake St. Ann settlement and runs across Isle and Chip lakes, and thence to McLeod river. In summer wagons may be taken as far as Chip lake, but from there pack horses must be used. The pack trail to Yellowhead pass runs across this township. The soil in the southern portion of the township is a good black loam with clay subsoil, and is very suitable for mixed farming. The surface is

Range 18—Continued.

covered with some small poplar, willow and some spruce and jackpine, and is rolling, sloping towards the McLeod, which flows through sections 2, 3 and 4. The northern portion of the township is chiefly spruce muskeg, with a few ridges of jackpine and poplar, and is not very suitable for farming. There are a number of creeks containing good water besides McLeod river. Fuel is very plentiful, but there are no minerals, stone quarries or water-powers. The climate is the same as that of Edmonton. No summer frosts were noticed. Bear, moose, grouse and partridge were seen. The creeks and river abound with fish of every description.—*R. V. Heathcott, D.L.S., 1907.*

Range 19.

40. (North outline.) Through the first mile and a half of this township the country consists chiefly of rolling land, covered with fallen timber, jackpine and spruce, suitable for building purposes. The soil is of a fairly good quality, consisting chiefly of loam.—*B. J. Saunders, D.L.S., 1908.*

43 and **44.** (East outlines.) At the present time there are only pack trails into this country. Going into that country from the south one may leave the Canadian Pacific railway at Morley, Banff or Laggan. The routes from these three stations join at 'Kootenay plains,' on Saskatchewan river. On inquiry, I learned that when the snow is not too deep the pack trail from the last station is the best and shortest, but that it can only be used during the months of July, August, September and October, on account of the great depth of snow at the Pipestone-Siffleur summit. The country along these lines is broken, hilly and mountainous, thickly covered with small spruce, balsam and poplar. There are numerous large muskegs and streams of good water. The timber is generally small, but there is considerable large timber along Brazeau river, in range 20. Many indications of soft coal occur near the south boundary of township 43. Fire has previously devastated the whole section of country south of the Brazeau, and there exist vast sections of windfall and brulé.—*T. D. Green, D.L.S., 1908.*

44. (See report for township 44, range 17, west of the fifth meridian.)—*A. H. Hawkins, D.L.S., 1908.*

48. (See report for township 48, range 18, west of the fifth meridian.)—*A. H. Hawkins, D.L.S., 1907.*

52. The trail from Edmonton to Yellowhead pass crosses the northwest corner of this township. The soil on the north side of McLeod river is black loam, with clay and sand subsoil, and is very suitable for mixed farming. To the south of the river it is chiefly afloat with muskeg, with sand on the jackpine ridges, and is not well adapted for agricultural purposes. The surface is rolling and covered with small poplar, willow and jackpine in the northern portion; to the south and along the river bank it is spruce, tamarack and jackpine, up to thirty inches in diameter. There are some good hay lands around the lakes in the north of this township. Wood is plentiful everywhere. Water can be obtained from McLeod river, the lakes and numerous small creeks. It is all fresh water. There are no minerals, stone quarries or water-powers. Bear, moose and partridge were seen. The climate is the same as that of Edmonton.—*R. V. Heathcott, D.L.S., 1907.*

53. The pack trail from Edmonton to Yellowhead pass runs through the southern part of this township. The soil is black loam, with clay and sand subsoil, and suitable for mixed farming. The surface is rolling and covered with poplar, spruce and jack-

Range 19—Continued.

pine, up to twelve inches in diameter, and can be used for building purposes. There are several small hay sloughs scattered through the township, also numerous small fresh water creeks. Wood for fuel is also plentiful. The climate is similar to that of Edmonton. There are no minerals, stone quarries or water-powers. Beds which are supposed to contain marl or gypsum lie in sections 5, 6 and 7, but no proper analysis has been made. Game consisting of bear, moose, grouse and partridge was seen. Sundance creek abounds with trout.—*R. V. Heathcott, D.L.S., 1907.*

Range 20.

43 and 44. (East outlines.) At the present time there are only pack trails into this country. Going into that country from the south one may leave the Canadian Pacific railway at Morley, Banff or Laggan. The routes from these three stations join at 'Kootenay plains,' on the Saskatchewan. On inquiry, I learned that when the snow is not too deep the pack trail from the last station is the best and shortest, but that it can only be used during the months of July, August, September and October, on account of the great depth of snow at the Pipestone-Siffleur summit. The country along these lines is broken, hilly and mountainous, thickly covered with small spruce, balsam and poplar. There are numerous large muskegs and streams of good water. The timber is generally small, but there is considerable large timber along Brazeau river, in range 20. Many indications of soft coal occur near the south boundary of township 43. Fire has previously devastated the whole section of country south of the Brazeau, and there exist vast sections of windfall and brulé.—*T. D. Green, D.L.S., 1908.*

Ranges 20 and 21.

48. Access to these townships is obtained by crossing McLeod river at 'Big eddy' and following the trail that leads up the west side of Embarras river. The soil is generally sandy loam, and gravel on the ridges, with vegetable mould and clay loam in the valley, and would probably raise good hay and oats, as well as potatoes and other garden produce. The country has been badly burnt over along the line, and is covered with small jackpine and willow brush, with a few meadows of small extent on the lower ground. There is a general ascent to the west and south, and generally in range 21 the surface is very broken, covered with dry standing timber, but fairly good grass is found in the valleys of the Embarras and its tributaries. No timber of commercial value is found in these townships, but probably sufficient for settlers' use and for fuel. No quantity of hay grows, except in ravines and gullies, which in this locality are small in extent. The surface is largely covered with willow brush and small jackpine. Water is fresh and the supply sufficient and permanent. The west fork of the Embarras is from one to one and one-quarter chains in width, six inches to three feet deep, has a current three to four miles per hour, and the adjoining lands are not liable to flooding. Power might be developed by damming the river where it cuts through the hills in range 21, as the fall is considerable above this point and the river very rapid. This locality is probably subject to summer frosts. The most readily available fuel is wood, of which there is abundance on all sides. There is said to be coal in range 21, several claims for which have been located, but no surveys made. Drift coal was observed in the river, but neither coal in place, stone quarries nor minerals of economic value were noticed. Game was very scarce, with the exception of a few traces of moose and bear.—*A. H. Hawkins, D.L.S., 1907.*

TOWNSHIPS WEST OF THE FIFTH MERIDIAN.

Range 20.

52. Yellowhead pass trail runs across this township about a mile south of the fourteenth base line. The soil, except on the north side of McLeod river, where it is black loam with clay subsoil and very well adapted for farming, is chiefly peat in the muskegs, with sandy ridges, and is very unsuitable for farming. The surface is rolling and covered with spruce, tamarack, jackpine and poplar. The spruce along the river measures up to three feet in diameter and will make good lumbering timber. The average size of the remainder is about ten inches. There are no hay lands. Water is supplied by McLeod river and several creeks of good fresh water. There is a large quantity of wood fuel, but no minerals, stone quarries or water-powers. Bear, moose, deer and partridge were seen. The climate is the same as that of Edmonton.—*R. V. Heathcott, D.L.S., 1907.*

53. There are no regular trails into this township, but it can be reached from the Yellowhead pass pack trail, which runs along McLeod river about a mile south of the fourteenth base line. The soil is a sandy loam, with clay, sand and gravel subsoil, and is not very suitable for farming. The surface is rolling and covered with spruce, tamarack and jackpine, with a few ridges of poplar. The timber will average about nine inches, and is suitable for building and fencing. There are a few hay sloughs scattered through the township, but they are of no importance. Water is plentiful in the numerous small creeks and lakes. There are no minerals, stone quarries or water-powers. Wood for fuel can be procured everywhere, as fire has been through most of the township and left quantities of dry wood. Bear, moose and partridge were the only game seen.—*R. V. Heathcott, D.L.S., 1907.*

56. (Part north outline.) This country is high rolling and covered with poplar and jackpine of thirty years' growth, while the bottom lands are covered with willow, alder and scrub, which would be easily cleared. From the base line the land slopes southward to a wide valley which occupies the centre of this township and beyond which rise high wooded hills. In the same valley, which continues in a northwesterly direction across township 53, flows a large creek intersecting the line in section 32. The whole country is covered with large dead trees, the remains of a forest of pine which had attained a diameter of twenty-four to thirty inches. The soil is clay mixed with sand, while the subsoil is generally gravel and stones.—*A. Saint Cyr, D.L.S., 1908.*

Range 21.

48. (See report for township 48, range 20, west of the fifth meridian).—*A. H. Hawkins, D.L.S., 1907.*

52. The only possible way of reaching this township in the summer months is by pack trail from Lake St. Ann settlement. By using sleighs in the winter a very good road has been opened up which follows the greater part of the way, lakes, rivers and sloughs. As it is possible to take a heavy load the whole distance, it is found that this is the more economical way of taking supplies into this country. From the report furnished the Department by Mr. Ross, D.L.S., in connection with the survey of the thirteenth base line I expected to be able to use wagons as far as Chip lake, but this I found to be impracticable at least in the earlier part of the season owing to continuous wet weather and the abnormal traffic over it by teams employed in the construction of the Grand Trunk Pacific railway. Although the contractors, Messrs. Foley Bros. and Stewart, were continually improving and changing this road, especially that portion south of Chip lake, it was impossible for a team to take anything more than an empty wagon over it. There are two pack trails as far as the "Big eddy" on

McLeod river, one is known as "Jock's" trail and the other the "Jasper" trail. Both these trails cross Pembina river at the old crossing or the "Jasper crossing." The first mentioned trail turns to the north of Chip lake as far as township 56 and thence in a southwesterly direction to the "Big eddy," the latter trail however runs almost due west, passing south of Chip lake and is by far the shorter trail. I found however that the first mentioned trail was the more suitable, although two days longer, owing to its being fairly dry in rainy weather, also on account of an abundance of feed for horses at all seasons. I found the "Jasper" trail very bad and almost impassable owing to its crossing a large number of wide and soft muskegs, long and continuous stretches of fallen timber, and also to the unsatisfactory condition of bridges. From the "Big eddy" the trail follows along McLeod river. I used this trail in the survey of this township to within three miles of The Leavings; from there I found it necessary to open a trail about four miles south to the centre of the township. As the rivers and lakes had broken up before I received instructions for this work I was unable to take in any of my outfit or provisions over the ice. The soil of this township is not of the very best; the higher ground has evidently been subjected to a succession of very severe fires which have burnt off the loam and left the clay subsoil hard and barren. This township is also unusually rough and for this reason not adapted for cultivation. A few quarter sections may be found here and there which would be suitable as homesteads but the greater portion would only be useful for grazing purposes. The township as a whole might be called scrubby although there are patches here and there of timber and brulé which have been burnt clear of stumps. The timber found in this township is not of commercial value with the exception of a strip along McLeod river, the balance, which is scattered areas, would be suitable only for a reservation for the settler. There is no hay of any value or extent in this township, the low ground being in almost every case a muskeg and unsuitable for hay unless drained. The water is of the very best, free from all alkaline or other impure substances. There is an abundance of springs and spring creeks flowing into McLeod river which passes through the northern part of this township. The climate is similar to that of the Edmonton district but is probably subject to earlier frosts and to excessive hail storms which follow the valley of McLeod river. The fuel at present that can be most readily procured is wood, but there is an unlimited supply of coal in the valley of McLeod river within a comparatively short distance.—*A. E. Farncomb, D.L.S., 1908.*

56. (North outline.) This township includes in its western half the valley of the Athabaska. This stream here flows north. In the eastern half lies some high land, alternating with spruce and tamarack swamps in sections 32, 34 and 36. In these the trees do not average more than eight inches. On the high land poplar and jackpine grow, while a few birch trees were also seen near the river. The land in this township is drained by a good sized stream rising in the hills, six or eight miles south of the line. Between its banks and the foot of the hills is some prairie land with first-class soil, but as the valley is narrow these prairies are of limited extent. The stream crosses the north boundary of this township near the corner of section 32, and two miles farther it joins Athabaska river. The soil is clay mixed with sand from four to eight inches deep, while the subsoil is invariably stony or gravel. As this country is not at present densely wooded and without any sort of trail, it will probably not be settled for a long time. At the crossing of the Athabaska, in the middle of section 31, the river is two hundred yards wide, is quite deep and flows northward at the rate of five or six miles an hour through a single channel. From the water's edge, along the right bank, rise perpendicular cliffs of sandstone, while the top of the left bank is not

Range 21—Continued.

more than five feet above the water. Half a mile north of the base line the stream bifurcates around a small wooded island, and a short distance below there is a bad rapid, where the water rushes underneath some overhanging rocky ledges, a dangerous spot which it would be hard to avoid with any kind of craft. I noticed several such rapids in this stretch of river. The valley of the stream above referred to is connected with the valley in range 20 by a traversed depression one mile south of the base, bearing east and west. Along the stream which drains this township beaver have for a long time been at work and appear to be getting very numerous, as evidenced by many new dams built at short intervals across its course. The remains of some old works which had been broken by the trappers are still visible, but now that all these trails have been made impassable by fallen timber, they do not visit this part of the country any more.—*A. Saint Cyr, D.L.S., 1908.*

Ranges 22, 23, 24 and 25.

48. Access to these townships is to be had by following the trail along McLeod river; for those lying west of the river the trail leaves the McLeod two miles north of the thirteenth base line, and for those lying east of the McLeod the trail follows up the river to the first large creek that comes in from the north and thence up this creek. The soil is all of a very sandy nature, except muskegs, where vegetable mould prevails, and is probably best adapted for forest culture, except along the valley of the McLeod, which is from one-half to three-quarters of a mile wide extending from seven to ten miles up the stream with but two or three small breaks for the entire distance. It is called locally 'Big prairie,' and is well adapted for hay, which could be cut in places without improvement, and would probably raise oats, potatoes and other garden produce, and would undoubtedly be an admirable range for the raising of cattle and horses. The surface is rolling and broken with many muskegs, and all timbered except the valley of the river. Some very fair pine and spruce is found along this line, cut up, however, by muskegs. Timber ranges from six to twenty-six inches in diameter, and is located at intervals all along these four ranges. Hay could be cut on 'Big prairie,' and with small improvements the quantity is unlimited. The water is fresh and abundant. McLeod river is one and a half chains wide, one to three feet deep, has a current of three and a half to five and a half miles per hour, and does not often flood its banks. Water-powers could be developed higher up the river. This locality is said to be subject to summer frosts. Wood is the only fuel, and is said to be abundant on all sides. No coal or lignite veins, stone quarries or minerals of economic value were noticed. Traces of bear, deer and moose were noticed, and a few grouse and, occasionally, ducks were seen, but game was generally scarce. A number of bull-trout were caught in McLeod river.—*A. H. Hawkins, D.L.S., 1908.*

Range 22.

52. The only possible way of reaching this township is by pack train in the summer months from Lake St. Ann settlement or Entwistle or by using sleighs in the winter. A very good winter road has been opened which to a great extent follows the lakes, rivers and sloughs. As it is possible to take a heavy load the whole distance, it has been found to be the most economical way of taking supplies into this country. From the report furnished the Department by Mr. Ross, D.L.S., in connection with the survey of the thirteenth base line, I expected to be able to use wagons as far as the west end of Chip lake, but this I found to be impracticable, at least in the earlier part of the season, owing to the continuous wet weather and the abnormal traffic over

it of teams employed in the construction of the Grand Trunk Pacific railway. Although the contractors, Messrs. Foley Bros. and Stewart were continually changing and improving this trail, especially the portion south of Chip lake, it was impossible for a team to take anything more than an empty wagon over it. There are two pack trails as far as the 'Big eddy' on McLeod river; one is known as 'Jock's' trail and the other the "Jasper" trail. Both these trails cross the Pembina river at the old crossing or the "Jasper" crossing, but the former trail turns north of Chip lake as far as township 56 and thence in a southwesterly direction to the "Big eddy." The latter trail however runs almost due west passing south of Chip lake and is by far the shorter trail. I found that the first mentioned trail was the more suitable, although two days longer, owing to its being fairly dry in rainy weather, also on account of an abundance of feed for horses through the summer months. I found the "Jasper" trail very bad and almost impassable owing to a great extent to its crossing a large number of wide and soft muskegs, long and continuous stretches of fallen timber, and also to the unsatisfactory condition of bridges, corduroys, &c. The feed also along this trail was very scarce owing to the large number of horses used on railway construction pasturing along it. From the "Big eddy" the trail follows along McLeod river. I used this trail in the survey of this township as far as The Leavings, and from there I followed a trail which continues up McLeod river. I also opened up and used an old disused trail which crosses the township along the first tie-line south of the base line. From Lac Ste Anne it took about thirteen days to reach the camp with a load and three weeks for a round trip. The soil in this township is of a very inferior quality, being either gravel or a very hard clay, the top soil or loam having been burnt off making it very unsuitable for agricultural purposes. The whole of this township with the exception of the southeast corner is covered by the Yellowhead mountains, being a range of very high and broken hills, which is the divide between Athabaska and McLeod rivers. It is also cut by the valley of the McLeod river rendering it valueless from an agricultural standpoint. The township as a whole might be described as being covered with brulé or dead fallen timber, which in some cases is piled as high as ten feet, with a dense second growth of small jackpine. Small areas of timber are found in sections 18, 19, 32 and 33 being all that is left of an immense forest covering the whole township. These small areas, however, are not of a sufficient size to be of any commercial value. The water in this township is unusually plentiful and of good quality, the source being springs flowing from the hills into Athabaska and McLeod rivers.—*A. E. Farncomb, D.L.S., 1908.*

53. The only possible way of reaching this township is by pack train in the summer months from Lake St. Ann settlement or Entwistle or by using sleighs in the winter. A very good winter road has been opened up which to a great extent follows lakes, rivers and muskegs. As it is possible to take a heavy load the whole distance, it has been found the most economical way of taking in supplies. From the report furnished the Department by Mr. Ross, D.L.S., in connection with the survey of the thirteenth base line, I expected to be able to team all my outfit at least to Chip lake, but this I found to be impossible, at least in the earlier part of the season, owing to continuous wet weather and the abnormal traffic over the trail of teams employed in the construction of the Grand Trunk Pacific railway. Although the contractors working on the above railway, Messrs. Foley Bros. and Stewart, were continually improving and changing this road, especially that portion south of Chip lake, it was impossible for a team to haul anything more than an empty wagon. There are two pack trails as far as the "Big eddy" on McLeod river; one is known as "Jock's" trail, and the other the "Jasper" trail. Both these trails cross Pembina river at the old crossing, or what is known as the "Jasper crossing," the former trail taking a

Range 22—Continued.

northwesterly course as far as township 56 and thence in a southwesterly direction to the "Big eddy"; the latter trail, however, runs almost due west following in the vicinity of the thirteenth base line and is by far the shorter trail. I found, however, that the first mentioned trail was the more suitable, although two days longer, owing to its being fairly dry in rainy weather, also on account of an abundance of feed for horses at all seasons. I found the "Jasper trail very bad and almost impassable for anything but unloaded horses owing to a great extent to its crossing a number of large and soft muskegs, long and continuous stretches of fallen timber being across the trail, and also to the unsafe condition of the bridges. From the 'Big eddy' the trail follows along McLeod river. I used this trail in the survey of this township as far as 'The Leavings'; from there I followed the north trail west about six miles, and from that point I located and opened a new trail about eight miles northeast to the centre of the township. From lake St. Ann with a load it took fourteen days to reach the camp, and three weeks to make a round trip. The soil at one time in this township was no doubt of the very best, but a succession of severe fires has burnt off the loam and baked the subsoil, although a very fair vegetation would indicate that it is capable of raising a very fair crop. The general condition of the surface, however, is too rough for the cultivation of any considerable areas, although here and there areas may be found sufficiently level to allow of its being utilized in this way. Large areas of muskegs, which at present are too wet for cultivation or ranging stock, may be very readily drained and made into the best of land. The greater portion of the township is timbered, although not of commercial value, the central and western portions being covered with scrub, with patches of spruce where the ground is inclined to be low and wet. The timber in this township is confined to a strip extending from lake No. 1 to the northeast corner of the township, but it is not of any great commercial value, as it would not average over eight inches in diameter. There are other patches here and there through the township which are not of sufficient extent for commercial purposes, but might be useful to the settler. There is no hay in this township which could be utilized unless considerable work was done in the way of drainage. The water is very plentiful and good, free from all alkaline or other injurious substances. Numerous springs and spring creeks are found in different parts of the township, especially on the slope to the Athabaska.—*A. E. Farncomb, D.L.S., 1908.*

56. (North outline.) The east boundary of this township follows the edge of a bench west of the Athabaska. The country here is lightly timbered with aspen, and there are a few scattered clumps of jackpine on the top of the ridges. Hay meadows are found at some distance north of a small creek which crosses the line several times before it empties into the river. Across these meadows and through the 'greenbush' which grows in this vicinity passes an old pack trail which, although not travelled for a great many years, is still visible in section 31, range 21. It cannot, however, be followed more than two miles south to where the brulé begins, and any further traces of it become obliterated under a mass of windfall. For that reason, the Indian hunters had to find another route farther west when going to the valley of Baptiste river, their old hunting grounds. The height of land (3,700 feet above the sea) between the valleys of Athabaska and Hay rivers is passed in the middle of this range. West of the summit the land remains fairly level through section 33, the west half of which is covered with tamarack and jackpine six to nine inches, and spruce and balsam six to twelve inches. Half of sections 31 and 32 are in swamps separated by strips of dry land supporting a stunted growth of aspen and jackpine. The soil is clay or clay loam overlying a stony subsoil.—*A. Saint Cyr, D.L.S., 1908.*

TOWNSHIPS WEST OF THE FIFTH MERIDIAN.

Range 23.

48. (See report for township 48, range 22, west of the fifth meridian.)—*A. H. Hawkins, D.L.S., 1908.*

52. The only possible way of reaching this township is by pack train in the summer and in the winter by sleigh road to 'The Leavings' on McLeod river, but from there to the township the only possible way is by pack train a distance of about eight miles. The winter route is by far the most economical. As I had not time after receiving my instructions to have my provisions taken in over the ice I was compelled to take everything in over to the pack trail. There are two pack trails as far as the 'Big eddy' on McLeod river, one is known as 'Jock's' trail, and the other the 'Jasper' trail. I found, however, that it was impossible to use the latter trail owing to the crossing of a large number of wide and soft muskegs which were almost impassable from continuous wet weather in May and June which carried away the bridges and destroyed the corduroys across the soft places. 'Jock's' trail although two days longer was far the better as it follows high ground and also as there is abundance of feed for horses. I found it necessary to open up a considerable portion of the old 'Jasper' trail from 'The Leavings' on McLeod river in order to reach the work, as the present trail to the Yellowhead pass crosses the divide between McLeod and Athabaska rivers about six miles farther south, the old trail being almost completely abandoned. The top soil in this township on the whole is probably better than that of the adjoining ones as it has not been subjected to fire to any great extent with the exception of the more southerly portions. This is largely due to a precipitous slope of the whole township to the north. The eastern outline follows along the divide between Athabaska and McLeod rivers which reaches a height of about 1,500 feet above either river, and the land falls from this outline to the Athabaska, the whole area being covered by spruce, jackpine and poplar which would average about eight inches in diameter. This area is swampy and wet from innumerable springs which flow from the hills, and from which cause, and from the slight evaporation owing to its northern slope, has preserved this area from fire. The subsoil, however, is either sand or gravel and for this reason and the very rough nature of the surface would render it unfit for agricultural purposes of any kind. The southern third of the township is high land probably 1,200 feet above Athabaska river and has been subjected to a succession of very severe fires which have burned off the top soil, the whole being covered with a thick growth of small pine. The fuel which at present can be most readily procured is wood, but there is every indication of coal along the banks of Athabaska river which may be found in sufficient quantities and developed in the future. This township is well watered by the Athabaska and from innumerable springs which rise in the west slope of the divide and flow into the Athabaska, all of which is free from alkali. There is no hay in this township of any value for ranching purposes. The whole of the northern two-thirds of this township is covered with timber as above mentioned, some of good quality, but the greater portion, however, being more suitable for ties than for lumber.—*A. E. Farncomb, D.L.S., 1908.*

53. The only possible way of reaching the township is by pack train in the summer and in the winter by a sleigh road to "The Leavings" on McLeod river, but from there to the township the only possible way is by pack trail a distance of about eight miles. The winter route is by far the most economical, the present rate for provisions to the surveys being about four cents per hundred pounds, whereas the rate in summer by pack trail is about eight cents per hundred pounds. As I had not time after receiving instructions to have my provisions taken in over the ice, I was compelled to take everything in over the pack trail. There are two pack trails as far as the 'Big eddy' on McLeod river, one is known as 'Jock's' trail and the other the

Range 23—Continued.

'Jasper' trail. I found, however, that it was impossible to use the latter trail owing to the crossing of a large number of wide and soft muskegs which were almost impassable from continuous wet weather in May and June which carried away the bridges and destroyed the corduroys across the soft places. "Jock's" trail although two days longer was far the better as it follows higher ground and also as there is an abundance of feed for horses. I found it necessary to open up a considerable portion of the old 'Jasper' trail from 'The Leavings' on McLeod river, in order to reach the work as the present trail to the Yellowhead pass crosses the divide between McLeod and Athabaska rivers about six miles farther south, the old trail being almost completely abandoned. The soil in this township on both sides of the Athabaska is of a very inferior quality and not suitable for agricultural purposes, being either very sandy on the lower ridges or hardpan on the hills. The township on the whole is very rough and would, in my opinion, be suitable only for grazing purposes. It is well watered by Athabaska river which passes diagonally from the southwest to the northeast corner and by innumerable springs which rise in the hills and flow into the Athabaska from both sides. The water is unusually good and free from all alkaline or injurious minerals. Hay in this township is very scarce but a poor variety might be found along the river bottom but not of sufficient quantity to be of any value. There is a little timber scattered throughout the township, especially to the northwest, but not of sufficient extent to be of any commercial value. The whole of the township has evidently been subjected to a succession of severe fires which have only left the timber in the muskegs and coulées, the areas burnt being now covered by small jackpine, small poplar and willow. The fuel which would most readily be obtained at present is wood, although there is every indication of coal areas along the Athabaska, which may be developed in the future.—*A. E. Farncomb, D.L.S., 1908.*

56. (North outline.) West of the northeast corner of this township the land is covered with thick brush and slopes gradually towards the valley of a creek which crosses the line twice in section 36. Beyond that stream is a plateau where jackpine is growing so thick that it is almost impossible for a man to make his way through it. In section 33 we came to the western edge of this plateau, and three-quarters of a mile farther west Hay river was seen flowing northwards in a valley sixty chains wide and four hundred and fifty feet below the general elevation of the adjoining country. The north boundary of this township intersects this river in the middle of section 32. Its banks here are low, and the distance between them is two hundred yards. The main channel of the river runs close to the right bank, is five feet deep and not more than three chains wide. Another channel, separated from the main one by high gravel bars covered with willow, was dry at the time of the survey (September). In section 5, township 57, range 23, there is a lake half a mile long. It lies along the foot of the hills west of Hay river. From the left bank and on the line extends a flat on which grow some large spruce trees. It ends half a mile farther at a bench two hundred and fifty feet high. The soil through this section of country is clay underlain with stones. —*A. Saint Cyr, D.L.S., 1908.*

Range 24.

48. (See report for township 48, range 22, west of the fifth meridian.)—*A. H. Hawkins, D.L.S., 1908.*

52. The only possible way of reaching this township is by pack trail in the summer and in the winter by a sleigh road to 'The Leavings,' on McLeod river; from this point, however, it is necessary to use pack horses to the Athabaska, as it is very rough and no winter road has been opened. The winter route is the most economical way

of taking provisions in, the winter rate being four cents per hundred pounds and the summer rate by pack horse eight cents per hundred pounds. As I had not time after receiving instructions to have my provisions sent in over the ice, I was compelled to take everything in over the pack trail. There are two pack trails as far as the 'Big eddy' on McLeod river, one is known as 'Jock's' trail and the other the 'Jasper' trail. I found, however, that it was impossible to use the latter trail, owing to its crossing a large number of wide and soft muskegs, which are almost impassable from continuous wet weather in May and June, which carried away the bridges and destroyed the corduroys across the soft places. 'Jock's' trail, although two days longer, was far the better, as it follows high ground and also as there is an abundance of feed for horses. I found it necessary to open up a considerable portion of the old Jasper trail from 'The Leavings' on McLeod river to Athabaska river in order to reach the work, as the present trail to the Yellowhead pass crosses the divide between McLeod and Athabaska rivers about six miles farther south, the old trail being almost completely abandoned. The soil over the greater portion of this township is varied, the hills being burnt bare and covered with very little vegetation, and the level portions being covered with muskegs. The general surface is very broken, rendering it unfit for cultivation, with the exception of bottom lands along the Athabaska, which extend about one mile north and three miles down stream from the west outline, and also occasional areas scattered throughout the township. About one-quarter of the area of the township might be cropped, but the balance is only suitable for grazing. Along some of the side hills is found excellent grazing, they being covered by peavine and other varieties of grasses. The northwest corner of the township is on an elevation of 1,000 feet above the Athabaska, the surface being a succession of ridges and precipitous drops cut by canyons. In the southeasterly portion of this township, covering sections 1, 2 and 3 and sections 12, 11 and 10, there is some fairly level land which is cut by small areas of muskegs. This whole area, however, has been subjected to a succession of severe fires which have burned off the loam and baked the clay subsoil to such an extent that I found great difficulty in excavating for the pits. I am very doubtful that this area would be suitable for farming purposes, as all the vegetable matter appears to have been burned from the soil. The township might be described as being covered by scrub, although there is a belt of very fine timber along each bank of the Athabaska. This, however, extends only about half a mile back from the river and three miles up stream from the east outline. There is also good timber in the northwest corner of the township, which covers part of section 30 and the whole of section 31; with these exceptions, there is no other timber in this township of any commercial value. The water in this township is abundant and of the very best quality, being supplied by innumerable spring creeks which flow into the Athabaska, flowing diagonally across the township. There is a little hay to be found along the bottoms of the Athabaska described above, but otherwise the areas are limited to small sloughs and around the margins of muskegs. The fuel which at present can be most readily procured is wood, but there is every indication of coal along the banks of the Athabaska, which may be found in sufficient quantities to be developed in the future.—*A. E. Farncomb, D.L.S., 1908.*

56. (North outline.) Hay river enters this township near its southwest corner, and two miles farther receives its largest tributary from the west. This affluent is the same which crosses the sixth meridian in section 13, township 55. Two miles below the junction Hay river turns almost due east across township 56, range 24, which it leaves in section 25. This width of the valley proper varies from half a mile to three-quarters of a mile. Wild hay grows on a few of the flats next to the river,

Range 24—Continued.

but the majority support a good growth of spruce from eight to twenty-four inches in diameter. This timber, being of good quality and conveniently situated, will become valuable as it is the only standing timber spared by the fires which overran this district years ago. West of Hay river is a plateau which supports only a stunted growth of aspen and jackpine. Adjacent to the line are also large areas of moss-covered land, void of vegetation and in spots very stony. In section 34 the land begins to slope towards the wide depression in which flows Baptiste river, whose high cut banks are plainly seen at six or eight miles north of the base line. When nearing range 25 the country is broken again by deep narrow valleys with small streams, all flowing northward. Bad windfall reappear on the highlands, while in the valleys still grow a few spruce and jackpine. Far to the west is seen a great valley, beyond which lies the rough country where a year ago I surveyed the sixth meridian. Looking south from the north boundary of this township I noticed, in section 26, a lake on the bench within a quarter of a mile of the right bank of Hay river, and beyond it a forest of firekilled trees which stretches away also to the southeast as far as the eye can reach. The soil on the highland is gravelly and stony; in the bottoms it is generally loam or clay mixed with sand, but the subsoil is everywhere stony.—*A. Saint Cyr, D.L.S., 1908.*

81. This township is divided into two parts, by Peace river, which enters the township in sections 17 and 18 and flows northeasterly through the centre of the township. That part of the township which lies to the southeast of the river can be reached only by crossing the river from the northwest side. This portion of the township is heavily timbered with poplar, spruce, balm of Gilead, cottonwood, white birch and willow. Starting at the river the hills rise in about one mile and a quarter from the river, to a height of eight hundred feet; from the top of this rise back from the river the country is nearly level. Adjoining the river banks are a few narrow strips of flat country. On the level back from the river the poplar averages about ten inches in diameter, the spruce eighteen inches and the birch six inches. On the hills and near the river, the poplar is larger, averaging twelve inches or more, the spruce ten inches and the cottonwood twenty inches, some of the latter being as large as four and one-half feet in diameter. The several varieties of timber are well distributed over all sections of this part of the township. The undergrowth is dense. The soil consists of from one to three inches of humus or black loam overlying clay subsoil. With the exception of a marsh in sections 2 and 3, no hay could be cut, though pasture in the form of peavine and grasses is found in the woods. Later in the summer water is very scarce at the top of the hill, and what there is is very hard and slightly alkaline. There are no streams and no lands are liable to be flooded. During this season no frosts occurred until late in August. Wood for fuel is plentiful. No coal or lignite veins were found. No stone whatever occurs, and no minerals were seen. A considerable number of ducks, a few ruffed grouse, geese and swans were seen. There are quite a number of moose and bear. A few beaver were seen around the banks of Peace river, but there are very few left in the country. With the exception of sections 31 and 32, which are nearly level, all that portion of this township which lies on the left bank of the river consists of rough hilly country, intersected by deep canyons down which small streams trickle. These creeks, after carrying off the spring flood water practically dry up; a few of the larger ones have a little water in them all summer. The hills are almost bare, but every little depression is filled with a dense tangle of scrub, poplar and willow. The ravines and canyons contain a small amount of timber, a few spruce averaging about eighteen inches in diameter and poplar averaging six inches in diameter. About fifty per cent of this part of the township is open. The soil is

two or three inches of black loam on a clay subsoil. The hills are so well drained that it would be practically impossible to raise any crop on them. A good pack trail follows the river bank from Shaftsbury settlement through this township to Dunvegan, more than fifty miles up the river. A wagon could be used in sections 31 and 32. A small creek runs through sections 33, 28 and 22. This water is very hard and the volume in summer is very small. No lands are liable to be flooded. No water-power could be developed. Practically no hay could be cut, but there is good pasture. Summer frosts rarely occur. Loose stones occur in places, especially near the banks of the river, but no stone in place was seen. Fuel in the form of small poplar and willow occurs throughout this portion of the township. No coal or lignite veins nor economically valuable minerals were seen, though a little float coal was picked up on the shore of the river. Peace river flows through this township at a rapid rate, the current averages two and one-half to three miles an hour. The river is about thirty chains wide, but numerous islands make many channels, some of which are dry at low water (August until the following spring.) The river water is fresh and not so hard as the other water in the country. In the spring flood the water rises from ten to eighteen feet but does no damage, as the banks are high. A few prairie-chicken, ruffed grouse, geese, duck, sand-hill crane and some sign of bear were seen.—*H. S. Holcroft, D.L.S., 1908.*

82. There are two main trails coming up the hill from Shaftsbury settlement in Peace river to this township, one from the rear of Lot No. 12, known as 'Brick's' trail, and one from Indian reserve No. 151 C, known as 'Xavier's' trail. Both of these trails are in fair condition but the ascent from Peace river to the top of the hill is about six hundred and fifty feet. 'Brick's' trail passes through sections 36, 35, 34, 33, 32 and 31, while 'Xavier's' trail passes through sections 1, 2, 11, 10, 9, 16, 17 and 18. From the top of the hill back from the river both these trails are good. They join in township 82, range 25, and pass by 'Old Wive's' lake to Dunvegan. The soil is black loam with a depth varying from two inches to six inches, overlying a subsoil of clay in the southern and eastern portions of the township, and a gravel subsoil in the northerly and westerly portions. The soil is suitable for growing all the products of the country. About fifty per cent of the township is open while most of the remainder is covered with willow and small poplar. All that part of the township lying to the southeast of a line drawn from the southeast corner of section 5 to the quarter section post on the east boundary of section 13 is hilly and broken by numerous ravines. The remainder of the township is gently rolling. A few spruce averaging from eight inches to ten inches in diameter occur in the ravines in sections 4, 12, 13, 14 and 24. Scattered throughout the remainder of the township are numerous bluffs of small poplar, with an occasional poplar averaging eight inches in diameter. No slough hay occurs. Upland hay could be cut in a moist season in sections 19, 20, 29, 30, 32, 21, 28, 33 and 27. The only places in this township where water occurs on the surface are in three small creeks, one heading in section 14, one in section 23, and one in section 4. These creeks head from springs; the water where it comes out of the ground is fresh but quickly becomes hard and slightly alkaline by absorption of salts from the surface soil; these springs are permanent. The remainder of the township is practically dry in summer time. No floods are liable to occur. No water-power of any importance could be developed The climate is mild and warm. During the past summer no frosts occurred, and the season was rather dry. A fine autumn was experienced. Fuel consisting of poplar, willow and some spruce is plentifully distributed throughout the township. No coal or lignite veins, nor minerals of economic value were seen. No stone in place was discovered. Game is scarce. A

Range 24—Continued.

few prairie-chicken, ruffed grouse, red foxes and coyotes were seen. Indian reserve No. 151 occupies the greater part of sections 20, 27, 28, 29, 32, 33 and 34. This is used principally as a hay reserve.—*H. S. Holcroft, D.L.S., 1908.*

Range 25.

48. (See report for township 48, range 22, west of the fifth meridian).—*A. H. Hawkins, D.L.S., 1908.*

81. A trail which leaves lot No. 1 of Shaftsbury settlement enters this township in section 33. This trail is in moderately good condition. The soil in this township consists of a layer of black loam varying from two to eight inches deep overlying a clay subsoil and should be suitable for growing all varieties of cereals and vegetables. The north half of the township is partly open. Bluffs of small poplar and willow are scattered throughout this portion of the township. Sections 4, 5 and 8 are also more or less open, while the remainder of the township is covered with a more or less dense growth of small poplar, balm of Gilead and willow. In sections 2, 3, 5, 6, 7, 12 and 13 are a few scattered spruce. In a large deep valley in sections 4, 5, 6, 7 and 18, and in sections close to Peace river, sections 2, 3, 10, 11, 12, 13, 14 and 24, the timber is heavier. Poplar and balm of Gilead run up to fourteen inches in diameter. The northern half of the township is rolling, the remainder rough and broken by hills and valleys especially near Peace river. A creek passing through sections 5, 6 and 7 runs in a valley of one hundred and fifty to one hundred and eighty feet deep with steep banks. This creek, with Coldsprings creek, which passes through sections 33, 28, 22, 21, 15, 10, 3 and 2, and Peace river, provide water for the township. These are the only places from which water can at present be procured, the remainder of the township being quite dry. Coldsprings creek rises from some cold springs in Indian reserve No. 151A just north of this township. The water in this creek is clear, cold, fresh and hard, the volume varies but slightly the whole year round. This creek averages about five or six feet in width and eight to twelve inches deep and flows softly. A considerable portion of the more level portions of this township could be irrigated from this creek. The valley of this creek is rather wide for damming it for power purposes. No land is liable to be flooded. One hay meadow occurs in section 32, but upland hay could be cut in most of the open places in the northern portion of the township. Fires run through the country every year, being started by those who have horses ranging out, these fires decrease the wooded area yearly and this year the fires burned so fiercely that they retarded the growth of the grass considerably. During the months of April, May and June the climate was mild and dry, a couple of light frosts occurred late in May, but did no harm. Sufficient rain fell to do considerable good for vegetation. No coal or lignite veins, stone in place or economically valuable minerals were discovered. Float coal was seen along the shores of Peace river. Bear and moose were seen, also a few prairie-chicken and ruffed grouse; ducks and geese flew over in large numbers. Signs of marten, foxes and coyotes were seen. There are no gophers or badgers. Evidences are present that elk once existed in this township but there are none now. The whole township would make an excellent ranching country, and the northern half a fine farming country.—*H. S. Holcroft, D.L.S., 1908.*

Ranges 26, 27 and 28.

48. The route for reaching these townships is by way of the Jasper trail to Prairie creek from which place trails lead to all the accessible portions. The western portion of township 48, range 27, is right along the 'Jasper' trail. The whole of range 26 lies in the mountains and is very rugged and broken, being traversed by Fold-

Ranges 26, 27 and 28—Continued.

ing mountains and also the Fiddle Creek range. The Folding mountains are covered with scant vegetation, but the Fiddle Creek range is composed of bold rugged peaks of bare rock. From the centre of range 27 the line passes over rolling hills upon which is considerable windfall, supporting in many places a luxuriant growth of grass, but is rather rolling and broken for cultivation. Range 28 lies wholly in the Athabaska valley but is rather marshy and crossed by numerous branches of the river and cuts along close to the south end of Mud lake which is formed by an overflow of the Athabaska. The timber is small on the east side but is rather large and fine and very thick after crossing the river. A very nice flat was noticed just north of the line on the west side of the Athabaska. Some very fine hay was observed in the various meadows to the north of Mud lake. The water is fresh and permanent in Fiddle creek and Athabaska river but Drystone creek was quite dry in August and is said to dry up each season. There are several good water-powers on Fiddle creek which could be developed by damming in numerous places where the creek cuts through the mountains. It ranges from fifty to eighty feet wide, and six inches to two feet deep, with a current four to six miles per hour. No water-power occurs along the Athabaska in this locality and the banks are subject to flooding during June and July. The Athabaska is four to ten chains wide, one to ten feet deep, and has a current very swift and treacherous, four to six and a half miles per hour. The water is milky in colour but good. Summer frosts are very rare in the valley but of frequent occurrence on the mountains. The available fuel is wood and is readily procured in many places. No coal or lignite veins were noticed. Limestone could be quarried in many places along the Fiddle Creek range; it appears to be of good quality and the supply is unlimited. No minerals of economic value were noticed although it is reported that there are several mineral claims staked in this locality. Near the head of the south and main fork of Fiddle creek are several hot sulphur springs situated about twelve or fifteen miles up the valley of Fiddle creek, from the Jasper trail, and may be reached by a trail leading from the Jasper trail near its crossing of Fiddle creek. Mountain sheep, red deer, a few moose, bear, wolves and foxes are to be found but are not at all numerous. There are said to be jackfish in the Athabaska and trout in the smaller streams.—*A. H. Hawkins, D.L.S., 1908.*

Range 27.

48. (See report for township 48, range 26, west of the fifth meridian.)—*A. H. Hawkins, D.L.S., 1908*

49 and **50.** These townships are easily accessible from the Jasper trail. They lie in the valley of Athabaska river; the soil is a sandy loam and very fertile in places, but becomes very sandy and gravelly near Brulé lake and Athabaska river and is not suitable for cultivation. To the east and along the Jasper trail are, however, some very fine tracts that could be easily cultivated, as evidenced by Mr. Gregg's ranch in township 50, range 26, along Prairie creek. At the time of my visit in August, garden produce was growing in great luxuriance and a small field of oats gave promise of an abundant yield. Mr. Gregg has quite a large drove of ponies and four or five cattle as well as a number of chickens, and has an ideal location. Several very desirable positions were noticed along Athabaska valley on the way down, which will doubtless soon be occupied. The surface was rolling and wooded along Athabaska river and Prairie creek with occasional considerable stretches of prairie. The timber is very fine and large in some places along the river but is small and rather stunted in growth as it leaves the water, and all of it is rather limby and rough. The water is all fresh and the supply abundant both in Prairie creek and in the Athabaska river. Power could

TOWNSHIPS WEST OF THE FIFTH MERIDIAN.

Range 27—Continued

be developed along Prairie creek in places by damming but no falls were noticed. The climate is said to be mild and equable the year round, very little snow falls in the valley and not much severe weather, with scarcely ever a summer frost as it is well sheltered on all sides by the mountains. Wood is the fuel most readily available and is abundant and near at hand at almost all points. No veins of coal or lignite were noticed. Game was scarce; a few traces of deer and bear were noticed but this locality is fairly well hunted. There are mountain trout in Prairie creek and jackfish and goldeye in the Athabaska. No minerals of economic value were noticed and no stone quarries except the mountains which afford an abundant supply of excellent limestone. —*A. H. Hawkins, D.L.S., 1908.*

Range 28.

48. (See report for township 48, range 26, west of the fifth meridian).—*A. H. Hawkins, D.L.S., 1908.*

TOWNSHIPS WEST OF THE SIXTH MERIDIAN.

Range 3.

79. This township is timbered with poplar, spruce and large willow; it is nearly level through the northern half but rolling and hilly towards the south portion. The soil is black loam varying from four to six inches in depth and overlying a clay subsoil. Brulé river crosses this township near the southeast corner and Spirit river, a tributary of Brulé river, passes at a short distance north of the correction line. Spruce from six to eighteen inches in diameter is found in large quantities along those two streams. There is no road to communicate with this township. The game found in that country is moose, bear, marten, coyotes and foxes. The climate is good with no early summer frosts.—*J. B. Saint Cyr, D.L.S., 1908.*

80. This township can be reached by the Green island road connecting with the Peace River Crossing and Dunvegan wagon road. The soil is suitable for farming purposes as it is composed of black loam varying in depth from four to five inches and overlying a clay or sandy clay subsoil. The surface is prairie and bluffs, and the country is undulating with the exception of the neighbourhood of Peace river and the different creeks draining this township, where it is hilly. Timber such as spruce and poplar for building and fencing purposes is plentiful. Fuel can be procured on almost every section of this township. Prairie and slough hay is also plentiful all through this country. Most of the creeks were dry at the time of the survey and those which were running contained hard alkaline water. The settlers intending to stay in that country would have to dam those creeks in order to keep a supply of water to last them all the year round. This can easily be done as the bottom of those ravines is very narrow. There are no water-powers and no mineral of any description has been found during the subdivision of that township. The climate is good with no early summer frosts. There is a limestone quarry on section 6 of this township. There is also an Indian reserve No. 152A in this township; it is partly situated on sections 4, 5, 8 and 9. The hills on the south side of Peace river are densely covered with spruce, averaging fifteen inches in diameter and suitable for lumbering purposes. The water of Peace river is very good and clear and the current is about four miles an hour. With the exception of a few coyotes and foxes, no game has been seen here.—*J. B. Saint Cyr, D.L.S., 1908.*

TOWNSHIPS WEST OF THE SIXTH MERIDIAN.

Range 4.

80. The Peace River Crossing and Dunvegan wagon road crosses this township from section 34 to section 18, it is a very good road. The soil is a black loam varying from four to eight inches in depth, resting on a clay or hard clay subsoil. The surface is prairie and bluffs, with the exception of the northwestern portion of this township which is timbered with poplar, spruce and large willow. The country is generally level or undulating, but the land adjoining Peace river, Muddy creek and Boucher creek is hilly and broken. Timber for building and fencing is plentiful in this township and fuel can be procured in large quantities on nearly every section. Hay is plentiful in the numerous sloughs scattered all through the township; there is also a large quantity of prairie hay. Muddy creek flows all the year round but the water is very muddy. Boucher creek was nearly dry at the time of the survey (August), and its water was hard and alkaline. Both creeks flow in very deep ravines. There are no water-powers and no mineral of any economic value has been found. There is a limestone quarry on section 7 west of Rat creek. This creek was also nearly dry at the time of the survey and its water was alkaline. A great quantity of spruce averaging sixteen inches in diameter is found in the ravines of Rat creek, Muddy creek, Boucher creek and also on the sidehills bordering Peace river. There is a current of about four miles an hour in Peace river and the water is very clear and good. All that southern portion of township 80, range 4, situated south of Peace river is thickly timbered with poplar, spruce and large willow. With the exception of a few coyotes, foxes and marten, no game was seen in that township.

(Dunvegan settlement.) Besides the two Hudson's Bay company's reserves in Dunvegan, I subdivided the northwest quarter of section 8 into lots, viz., lot 1 and lot 2, and on the south side of Peace river east, adjoining the Hudson's Bay company's reserve lot 3, a small parcel of land where the Roman Catholic mission have a building. The front road on the north side of Peace river was surveyed through the Hudson's Bay company's reserve, going east as far as the east boundary of section 8.—*J. B. Saint Cyr, D.L.S., 1908.*

Range 5.

77 and 78. The country adjoining the east boundary of these townships can be reached by the Dunvegan, Spirit river and 'Grand prairie' wagon road and also by the Spirit river and Egg lake road. The greatest portion of township 78, range 5, and the middle part of township 78, range 4, is prairie and bluffs; there is also some prairie near the north boundary of township 77, range 5. The remaining part of those townships is timbered with spruce, jackpine and large willow. The largest quantity of spruce and jackpine is found north of the twentieth base line and along Brulé river. This stream crosses in a northeasterly direction townships 77 and 78, ranges 4 and 5. The water of Brulé river is very clear and good; the current is very swift in that stream but there was very little water in it at the time of the survey. Swamp creek, a tributary of the Brulé river, has also good water. The soil in the above mentioned townships is a black loam varying from five to six inches in depth with a clay or hard clay subsoil. Besides the streams draining that country I believe that water can be procured by boring deep enough.—*J. B. Saint Cyr, D.L.S., 1908.*

79. The country adjoining the east boundary of township 79, range 5, can be reached by the Dunvegan and Spirit river wagon road. The soil is a black loam varying in depth from six to seven inches overlying a clay subsoil and is well adapted for farming purposes. About one-third (the southern portion) of township 79, range 4 and the south half of this township is prairie and bluffs. The remaining portion in those two townships is covered with poplar and spruce averaging fifteen inches in

Range 5—Continued.

diameter with clumps of large willow, here and there. The country is undulating with the exception of the south part of those two townships where it is rolling. Spirit river crosses township 79, range 4 from west to east on sections 7, 5, 4, 3, 2 and 1; and township 79, range 5 on sections 12, 1 and 2. In the ravine of the river as well as on the sidehills there is a good quantity of spruce from eight to eighteen inches in diameter. Township 79, range 5 is also crossed from the northeast to the southwest by the deep ravine of Rat creek. This stream is a tributary of Peace river. Spruce of good dimension is plentiful on both sides of that creek which was nearly dry at the time of the survey. There are no water-powers in that district.—*J. B. Saint Cyr, D.L.S., 1908.*

Range 12.

19, 20 and 21. The land surveyed lies in the valleys of Chase and Charcoal creeks. The general direction of Chase creek is nearly due north. The stream averages twenty-five links in width and eighteen inches in depth and has a fall of about one hundred feet to the mile. In township 19, range 12, the creek bottom is only a few chains in width but in sections 7 and 18 there is some level land at a slight elevation above the creek. The soil is light and not very suitable for agricultural purposes. Farther down the creek, in sections 19 and 30, township 19, range 12, and in sections 24 and 25, township 19, range 13, there is a considerable area of fairly level land at an elevation of about one hundred feet above the creek. This land is, for the most part, lightly wooded, chiefly with jackpine and poplar, and is traversed by several small creeks. Section 24 in the latter township is probably the best for agricultural purposes. In township 20, range 12, the valley widens out and the creek bottom increases to twenty chains in width. The bottom land is densely wooded with cedar, spruce and cottonwood. The soil is a good black loam. Charcoal creek runs in a southwesterly direction and empties into Chase creek near the northeast corner of section 19, township 19, range 12. A high ridge rises quickly from the point where the two creeks join and separates the two valleys. From the mouth of Charcoal creek, for a distance of a mile and a half up stream the banks rise up steeply on each side. Above this there is a stretch of good bottom land three or four miles in length and varying in width from a quarter to three-quarters of a mile. The bottom land is covered with thick brush and poplar, willow, spruce, fir and jackpine. The soil is a good black loam with a covering of vegetable mould. There is some grazing land on the hillside to the north of the creek. Both Chase and Charcoal creek valleys are subject to summer frosts. Most of the potato crop was frozen in the last week of July. In places not exposed to the early morning sun very little injury was done. Six or seven settlers have located in the part surveyed, but only two were living on their places at the time of survey. Dairying and stock raising on a small scale could be carried on successfully. There are several roads leading to the upper end of the valley, but a more serviceable and better road could be made along Chase creek, connecting with the main road near Shuswap.—*J. E. Ross, D.L.S., 1908.*

Range 13.

19. (See report for townships 19, 20 and 21, range 12, west of the sixth meridian). —*J. E. Ross, D.L.S., 1908.*

20. The land surveyed is mostly rough and rocky. The elevation is 2,000 feet above Thompson river. In section 20 there is a small strip of good land and again in the southeast quarter of section 28 and in the northwest quarter of section 27, there is some good level land, heavily wooded, at an elevation 1,100 feet above the Thompson.

Range 13—Continued.

It can be reached at present only by a rough trail from a point on the Kamloops-Shuswap wagon road, but a fairly good road can be made at a moderate cost.—*J. E. Ross, D.L.S., 1908.*

Range 14.

19. Part of sections 35 and 36 were surveyed in this township. The land is rolling and lightly wooded with fir and pine. The elevation is about 800 feet above Thompson river. There is a good road leading to Ducks, a station on the Canadian Pacific railway, eight miles distant. The soil is a good sandy loam and water is scarce, but sufficient water for domestic purposes can be obtained from wells.—*J. E. Ross, D.L.S., 1908.*

20. I surveyed the north boundary of section 24 in the north half of which a settler has located and made a snug farm out of some forty or fifty acres lying in a depression in the tops of the hills within a mile or two of Thompson river. The elevation is about 1,000 feet above the river. There is some good grazing land on the hills. There is a good wagon road, but it takes a circuitous route to avoid too steep grades.—*J. E. Ross. D.L.S., 1908.*

Range 15.

19. In sections 21 and 22 there is a little good land but it is considerably broken up with rocky ridges. The south halves of sections 15 and 16 lie on a steep rocky hillside.—*J. E. Ross, D.L.S., 1908.*

20. The several sections surveyed lie in the southeast corner of the township. They lie on top of the hills at an elevation of 2,000 feet above the river. The land is timbered and broken with rocky ridges. One settler has located here and made a snug home for himself. I think a few more settlers could be placed here. Water can be obtained by digging. A road leads to Ducks station, Canadian Pacific railway, by a circuitous route.—*J. E. Ross, D.L.S., 1908.*

Range 16.

18. The survey here was a retracement of old surveys. The part surveyed lies on top of the hills surrounding Campbell and Scuittoe lakes at an elevation of 3,500 feet above sea-level There is some good meadow land around the lakes but this has all been taken up together with all the suitable land for settlement. Dairying and stock raising are the only branches of farming that can be carried on. There is an abundance of timber and firewood for all local purposes. The soil is a good sandy, gravelly loam.—*J. E. Ross, D.L.S., 1908.*

19. The survey was partially a retracement. The portion surveyed lies in a thickly wooded sidehill sloping northwesterly to Campbell creek. The altitude varies from 1,800 to 3,000 feet above sea-level. Most of the land is too broken for cultivation. Water is scarce and in the ponds it is alkaline, but sufficient for domestic purposes can be obtained by digging. There is considerable timber, pine and fir, averaging fifteen inches in diameter, fit for milling. Two settlers located immediately after the survey. There is suitable land for a few more.—*J. E. Ross, D.L.S., 1908.*

20. The land surveyed consists of some fractional sections on the north side of the South Thompson river, and along the north side of the Harper ranch, distant about ten miles from Kamloops from which there is a good wagon road. The sections along the river are broken by a line of clay bluffs one hundred and fifty to two hundred

Range 16—Continued.

feet high. From the base of the hills to the river, a distance varying from a few chains to nearly half a mile, there is a gradual slope of open land covered with sage brush and suitable for farming if water were obtainable. The sections north of the Harper ranch are mostly along a rocky sidehill partly open and partly timbered with pine and fir. In section 15 there is some good rock suitable for quarrying. In sections 11 and 14 there is some land suitable for farming if water for irrigation purposes could be procured. A small creek flows through the land. It is used for irrigating the ranch above mentioned.—*J. E. Ross, D.L.S., 1908.*

Range 17.

21. Two parcels of land were surveyed, fractional section 16 adjoining Kamloops Indian reserve and Lot 315. The former is hilly and open with some scattered pine and fir. There is no water. Lot 315 is a low lying flat in a bend of North Thompson river. It is covered with poplar, willow and alder with large cottonwood along the river bank. The surface is undulating, low rounded ridges and hollows alternating, and, in consequence, not suitable for irrigation. Most of the lot would be submerged at the highest floods and part of it at ordinary high water. Although suitable for fruit or vegetables, and convenient to the Kamloops market, it is not valuable through being subject to floods.—*J. E. Ross, D.L.S., 1908.*

22. I completed the surveys of sections 35, 36 and 26. The survey of the two first mentioned sections was delayed through the boundaries of Lot 338, which occupied the best part of the two sections, being lost. However, by an arrangement between the agent and the owner, the survey was rendered possible.—*J. E. Ross, D.L.S., 1908.*

Range 21.

20. The land surveyed lies almost immediately south of Savonas, a station on the Canadian Pacific railway, to which there is a good road. The elevation runs from one hundred to one thousand feet above the station. The surface is hilly, partly timbered and partly open. At present it is used only for grazing land. The soil is good, but irrigation is necessary.—*J. E. Ross, D.L.S., 1908.*

Range 22.

15 and **16.** The land surveyed here lies on the top of a mountain at an altitude of 5,000 feet. In the southwest quarter of section 34, township 15, there is a wild hay meadow of considerable size, and smaller ones are scattered through the adjoining sections. The surface is hilly and undulating and covered with a thick growth of jackpine. The soil is light and sandy. A trail has been blazed out from the meadow to the valley of Shuhun creek, where there is a good pack trail.—*J. E. Ross, D.L.S., 1908.*

23. The chief object of the survey was to locate some wild hay meadows. The line surveyed runs through timber westerly from the valley of Deadman creek and rises 2,000 feet in the first two miles, reaching the top of the escarpment running parallel with the creek. From the top the line runs westerly and parallel to Barricade creek. The surface is rolling and covered with a thick growth of jackpine. The soil is of poor quality and the country is useless except for a little grazing.—*J. E. Ross, D.L.S., 1908.*

TOWNSHIPS WEST OF THE SIXTH MERIDIAN.

Range 23.

20. Section 31, the only section surveyed, is fitted only for grazing, as there is no water for irrigation. There is no wagon road and at present the section is not easy of access.—*J. E. Ross, D.L.S., 1908.*

23. The land surveyed is rolling and covered with a thick growth of jackpine. Being at an altitude of 4,000 to 5,000 feet above sea-level it is not suitable for general farming. There is a good wild hay meadow of nearly one hundred acres in the south-east quarter of section 14, at the head of Barricade creek, which runs easterly and empties into Deadman creek about twenty miles from Savonas. There is a pack trail from the meadows to Deadman creek valley, where a road runs to Savonas.—*J. E. Ross, D.L.S., 1908.*

Range 24.

19. The part surveyed on the east side of Thompson river adjoins Oregon Jack Creek Indian reserve No. 6. It is hilly and broken in general, but there is some arable land. Water for irrigation is needed, but it is apparently not obtainable. It is partly open and partly openly timbered with fir and pine. There is a small patch of good bottom centred around the northeast corner of section 21, of which a part has been cultivated. The wagon road from Ashcroft to Highland valley runs through the part surveyed. On the west side of Thompson river I made a resurvey of some provincial lots and some fractional sections.—*J. E. Ross, D.L.S., 1908.*

20. The land surveyed is situated on the south side of Thompson river, and most of it about four miles east of Ashcroft, at an altitude of about 3,000 feet above sea-level. The land is rolling, hilly and broken, partly open and partly timbered with fir and pine. As there is no water for irrigation the land is fitted only for grazing. There is no direct road to the river, probably on account of the steep hillside.—*J. E. Ross, D.L.S., 1908.*

Range 25.

17. The land surveyed here is within two or three miles of Spence Bridge, a station on the Canadian Pacific railway. On the east half of section 16 there is a little good land. It is not easy of access at present as there is no road and a steep ascent of 2,000 feet or more.—*J. E. Ross, D.L.S., 1908.*

18 and **19.** The work in these townships consisted of a resurvey of some provincial lots and a survey of a few sections to complete the portion fronting on Thompson river.—*J. E. Ross, D.L.S., 1908.*

Range 26.

16. The part surveyed lies in the northerly end of the Botanie creek valley. The valley is about one and one half miles wide and has steep mountains on the east and west sides. It is hilly and rough and covered with a thick growth of small woods. There is some timber, fir and pine, on the east side of the creek. It is well watered and adapted for dairying and stock raising. The altitude is probably too great for general farming. There is a good road down the valley to Lytton station, about ten miles distant.—*J. E. Ross, D.L.S.,1908.*

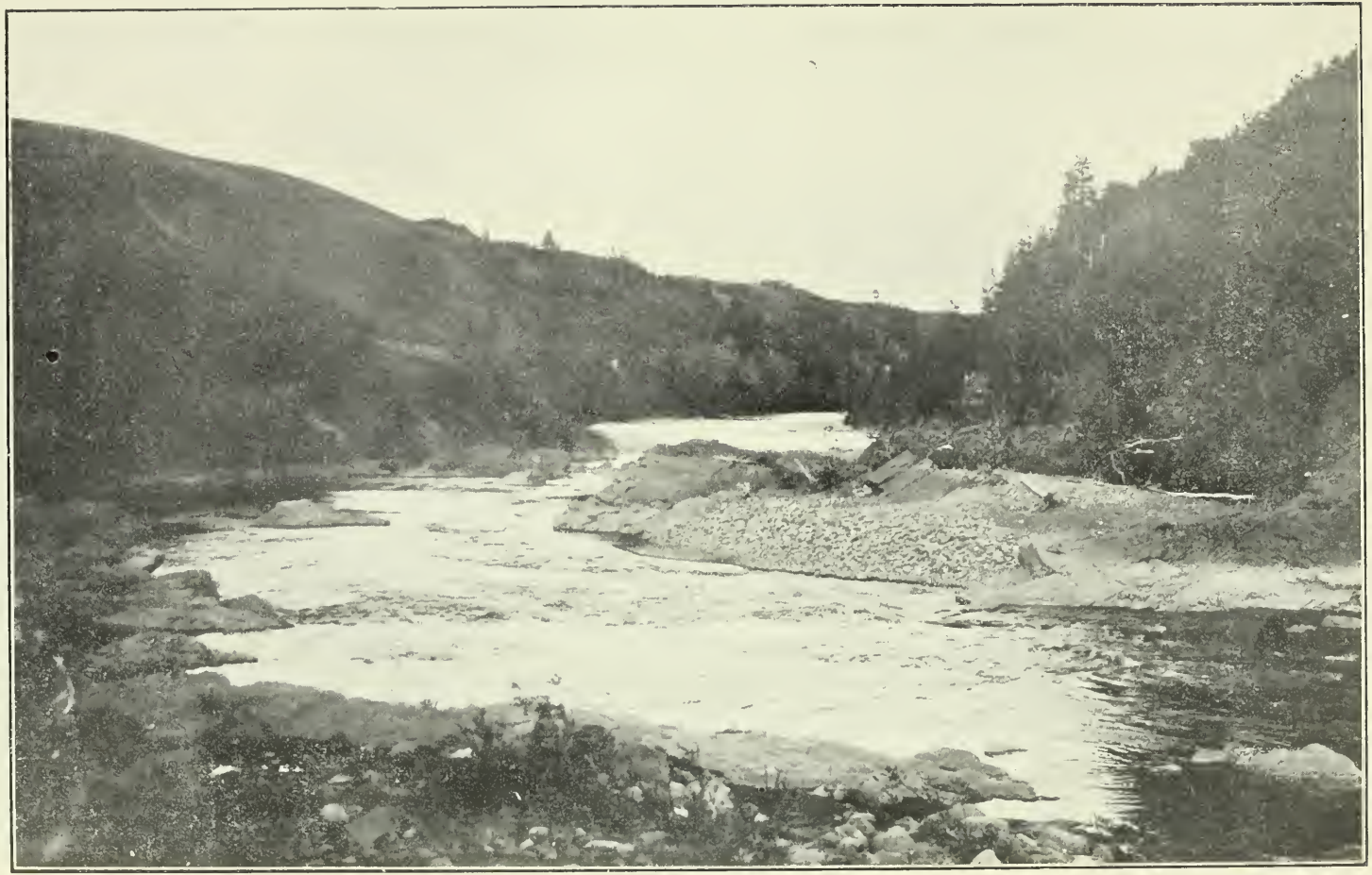
⊕

Looking up Blaeberry River. Photo. by P. A. Carson.

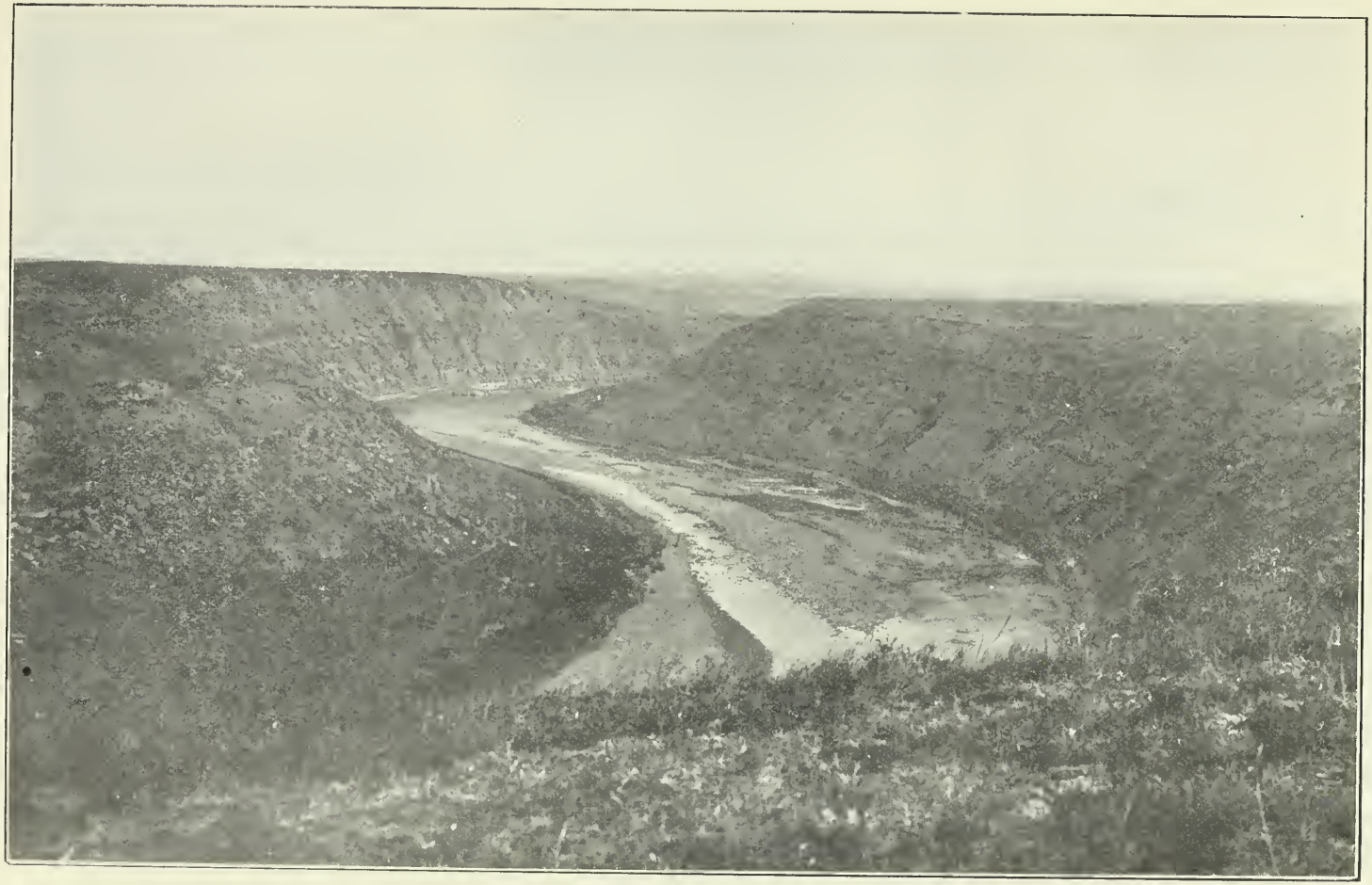
Blaeberry Falls. Photo. by P. A. Carson.

Six-Mile Creek Pass. Photo. by P. A. Carson.

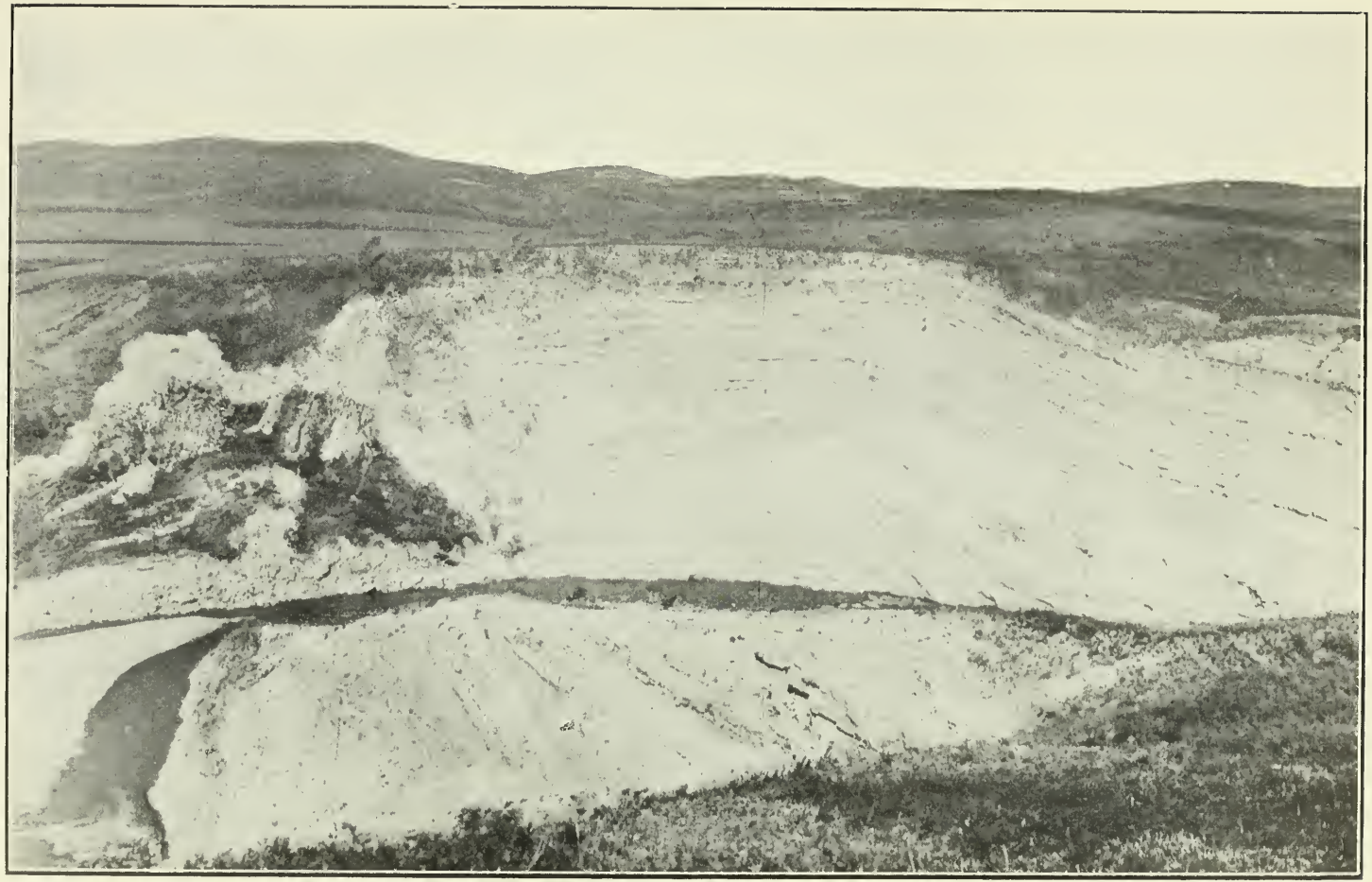
Waterton River Canyon. Photo. by W. Thibaudeau.



Canyon on Southfork River. Photo. by W. Thibaudeau.



Canyon on St. Mary River. Photo. by W. Thibaudeau.



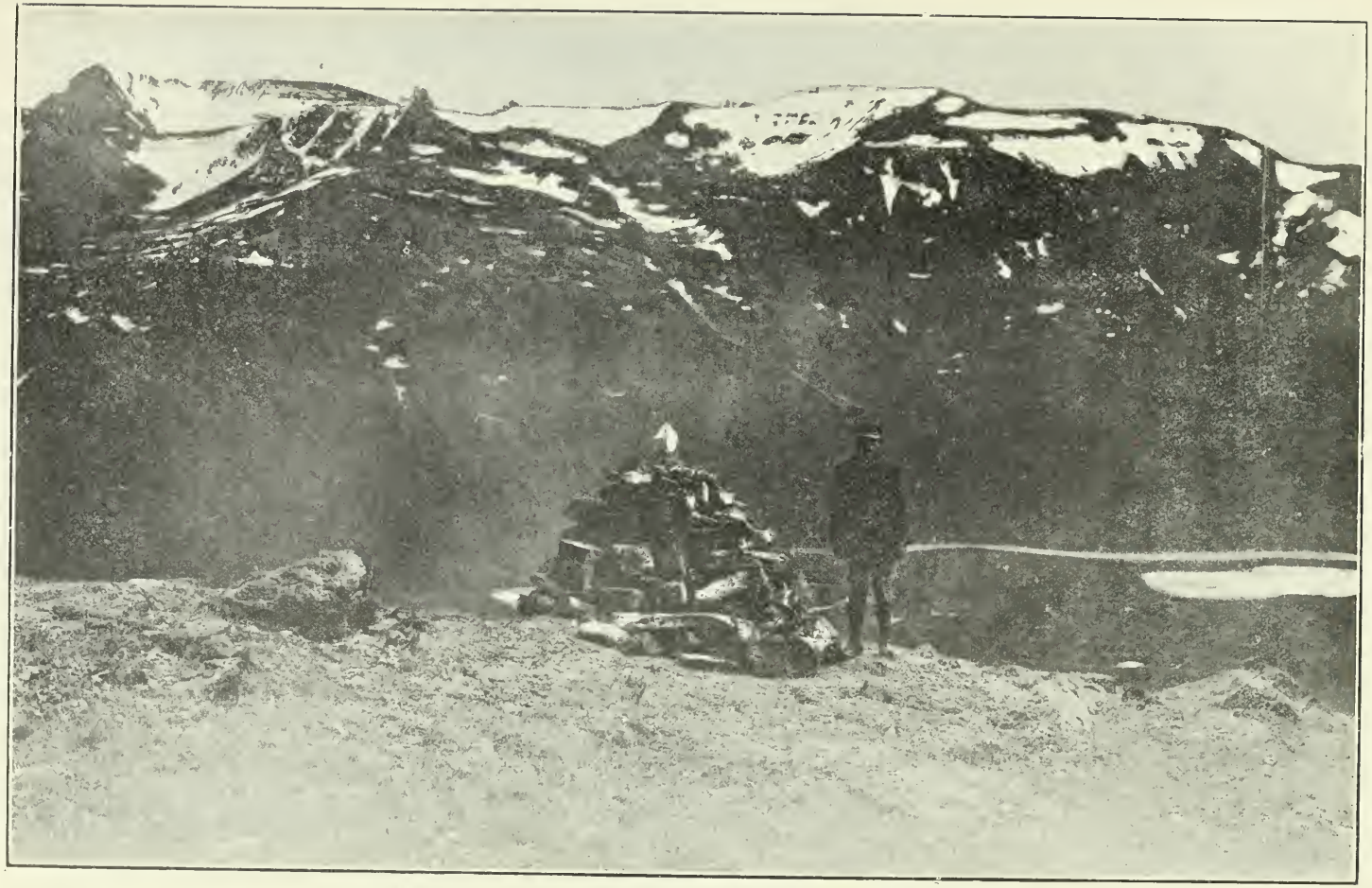
Crowsnest Pass. Photo. by W. Thibaudeau.

Packing up Dalton Trail. River Bottom. Photo. by G. White-Fraser.

Crossing Tatshenshini River at Dalton Post. Photo. by G. White-Fraser.

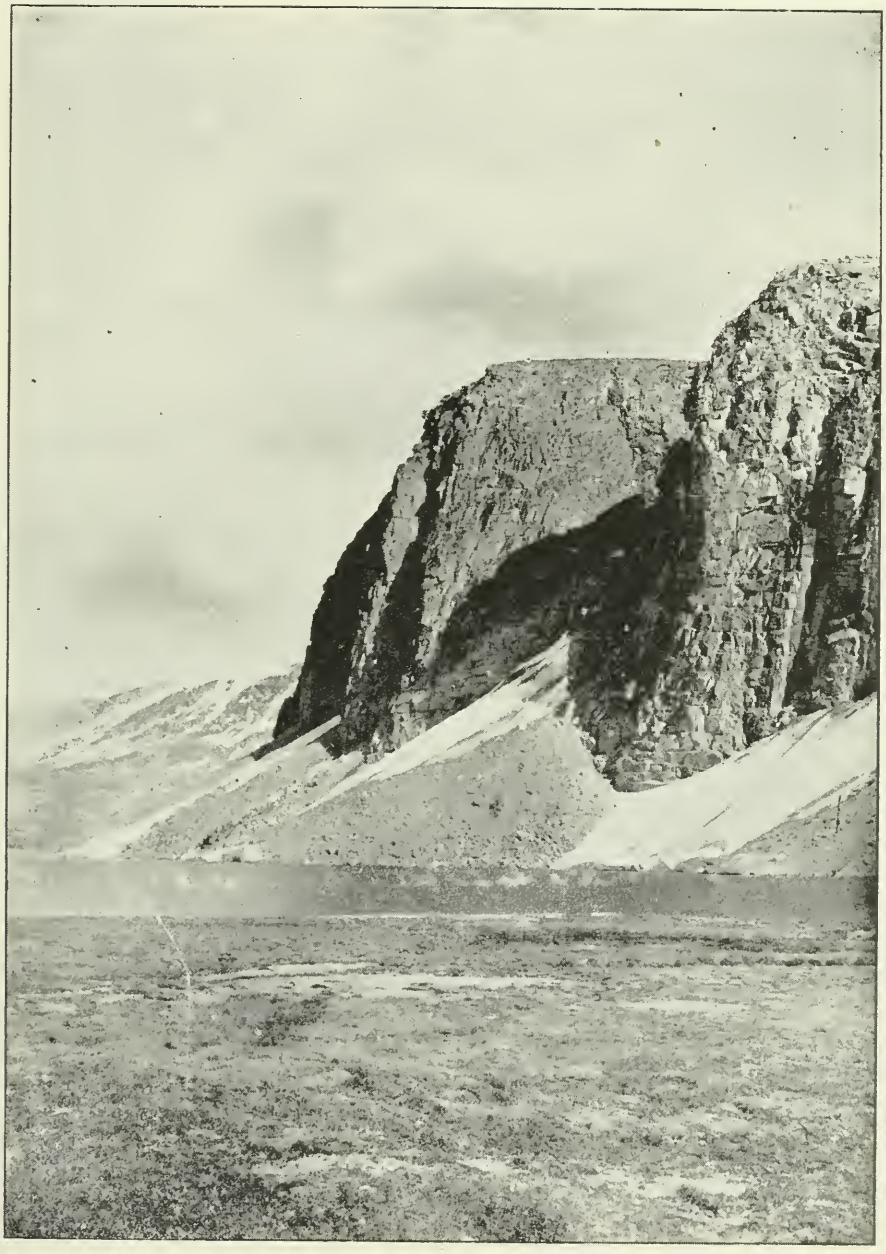
Looking West across Tatshenshini River. Photo. by J. N. Wallace.

Earth Mound, No. 147 on the B.C.-Y.T. Boundary. Photo. by J. N. Wallace.



Stone Mound, No. 141 on the B.C.-Y.T. Boundary. Photo. by J. N. Wallace.

Looking East across Blanchard River. Photo. by J. N. Wallace.

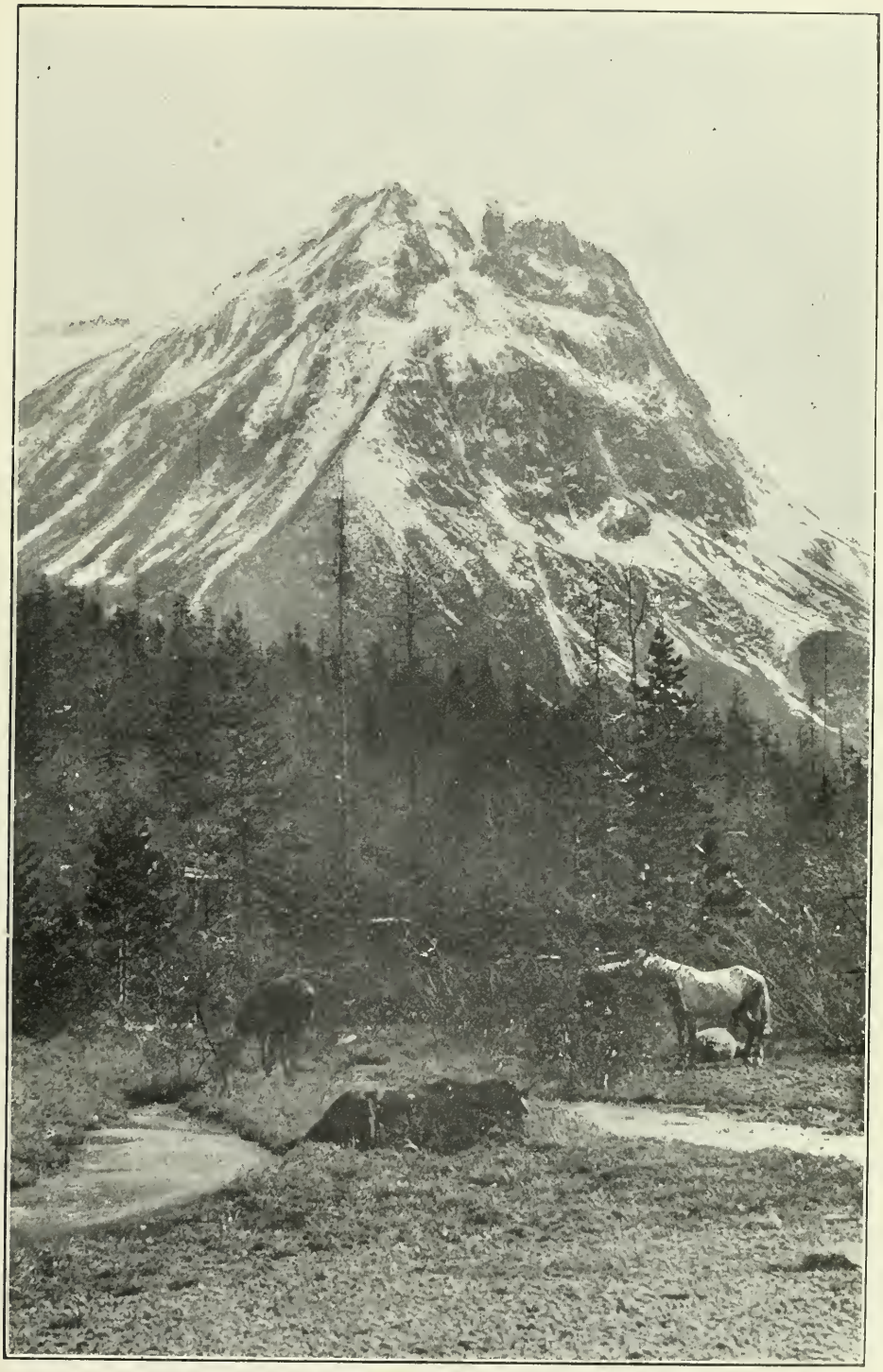


Lake on Summit overlooking Takhini River. Photo. by G. White-Fraser.

Takhini River, looking West. Photo. by A. Saint Cyr.

Lake Partridge. Photo. by A. Saint Cyr.

Gorge at the Head of West Arm. Photo. by G. White-Fraser.



Cleft Mountain. Head of West Arm. Photo. by A. Saint Cyr.

West Shore of Taku Arm. Photo. by A. Saint Cyr.

DEPARTMENT OF THE INTERIOR

REPORT

OF THE

HIGH COMMISSIONER FOR CANADA

FOR

Year ended March 31, 1909

PRINTED BY ORDER OF PARLIAMENT

OTTAWA
PRINTED BY C. H. PARMELEE, PRINTER TO THE KING'S MOST EXCELLENT MAJESTY
1909

[No. 25c—1910]

REPORT

OF THE

HIGH COMMISSIONER FOR CANADA

OFFICE OF THE HIGH COMMISSIONER FOR CANADA,
17 VICTORIA STREET, LONDON, S.W., September 23, 1909.

The Honourable
The Minister of the Interior,
Ottawa.

SIR,—I have the honour to transmit the annual reports of the emigration agents of your department in Europe for the year ended March 31, 1909. These gentlemen are as follows:—

J. Obed Smith, Assistant Superintendent of Emigration, 11-12 Charing Cross, London, S.W.
Alfred F. Jury, Old Castle Buildings, Preeson's Row, Liverpool.
G. H. Mitchell, 139 Corporation street, Birmingham.
A. McOwan, 81 Queen street, Exeter.
L. Burnett, 10 Parliament street, York.
John Webster, 17-19 Victoria street, Belfast.
John McLennan, 26 Guild street, Aberdeen.
Edward O'Kelly, 44 Dawson street, Dublin.
Malcolm McIntyre, 35-37 St. Enoch square, Glasgow.

(The above reports are published in, and form part of, the annual report of the Interior Department.)

I much regret to have to record the death of Mr. H. M. Murray, late emigration agent at Exeter, an officer of some thirteen years' standing.

The practice adopted in previous years of sending Canadian delegates, men of substance, who have made a success of farming in Canada, to visit the United Kingdom for the purpose of supplementing the work of the permanent agents, has been continued. The following is a list of the delegates sent during the season under review:—

Mr. John Bildfell (as agent for Iceland).
Mr. John Bainsley, of Abernethy, Sask.
Mr. S. Y. Bullis, of Watson, Sask.
Mr. C. R. Duxbury, of Elkhorn, Man.
Mr. P. Escaravage, of Wauchope, Sask.
Mr. Joshua Fletcher, of Ellerslie, Alta.
Mr. W. Griffiths, of Brockville, Ont.
Mr. William Lang, of Strathcona, Alta.
Mr. C. C. Meyer, of Ottawa.
Mr. Myles MacArthur, of Whitewood, Sask.
Mr. Leon Morel, of Edmonton, Alta.
Mr. Joseph Oliver, of New London, Alta.
Mr. Haderer.
Mr. Thomas Sales, of Langham, Sask.
Mr. William Spurrell, of Blackfalds, Alta.
Mr. James Swain, of Morris, Man.
Mr. Gottfried Schaffer, of Humboldt, Sask.
Mr. James Sinclair, of Prince Albert, Sask.
Mr. Herbert Wilkinson, of Meota, Sask., and
Mr. van den Broeck.

The effect of the world wide depression, which commenced in the latter part of 1907, and was particularly felt in the United States, continued throughout the year 1908 in an even more acute form, and Canada was naturally affected with the other countries.

Among the effects largely attributable to this depression is a considerable decrease in the volume of emigration not only from Europe to Canada, but also from this continent to the United States, and all the transatlantic steamship companies carrying passengers have experienced a great shrinkage in their traffic.

It must also be added that the restrictive measures which, on the advice of your department, the Canadian government have adopted, while they have undoubtedly had the effect of debarring that more or less undesirable class of emigrant which from one source or another was entering Canada, have at the same time been a factor making for a decrease in emigration. While there may be a tendency in certain quarters to cavil at these restrictive regulations, no one having the best interests of Canada at heart but will desire that the class of those emigrating to Canada shall be of the very best.

The following figures, derived from the statistical tables relating to emigration and immigration from and into the United Kingdom, recently laid before the House of Commons by the President of the Board of Trade, will be of interest:—

MOVEMENT TO CANADA.

1908.			1907.		
British Subjects.	Non-British.	Total.	British Subjects.	Non-British.	Total.*
81,321	14,107	95,428	151,216	34,560	185,831

Arising from the depression already mentioned, there was a slight increase in the movement from Canada to the United Kingdom, and the figures are given below:—

1908.			1907.		
British Subjects.	Non-British.	Total.	British Subjects.	Non-British.	Total.*
39,866	23,213	63,079	33,691	19,770	53,477

The excess of emigration to Canada over this inward movement is shown in the following figures, and it will be noticed that the movement from Canada to the United Kingdom in 1908 of persons of non-British origin is considerably more than the movement to Canada from the United Kingdom in the same category:—

1908.			1907.		
British Subjects.	Non-British.	Total.	British Subjects.	Non-British.	Total.*
41,455	9,106	32,349	117,525	14,790	132,354

*Includes a number whose nationality was not distinguished.

SESSIONAL PAPER No. 25c

The decrease in the emigration of British subjects to Canada continued in the first quarter of 1909, but the balance was to some extent redressed by a decrease in the inward movement to this country. A considerable increase in the outward movement of foreigners is also noticeable, and there has been a large decrease in the inward movement from Canada of non-British subjects, the balance showing an increase in favour of Canada over the figures of the first quarter of 1908 of 6,470. The net increase in the emigration into Canada from or passing through the United Kingdom for the quarter is 4,904. The table is given below:—

	First Quarter of 1909.			First Quarter of 1908.		
——	British Subjects.	Non-British.	Total.	British Subjects.	Non-British.	Total.
Outward....	12,916	4,525	17,441	15,774	2,482	18,256
Inward.....	3,611	1,045	4,656	4,903	5,472	10,375
Balance ..	9,305	3,480	12,785	10,871	2,990	7,881

The news cable service instituted in October, 1906, continues to give satisfactory results. The cablegram forwarded to me weekly by your department, containing news which is of interest to the general public as well as to the commercial community, is circulated not only to the press but furnished direct to the Canadian railway and steamship concerns represented here, the heads of all the great financial institutions, the Canadian emigration agencies, and also to a large number of influential financiers and others identified with Canadian interests in this country. Many of the concerns to whom this information is conveyed have excellent facilities for displaying the cable messages in conspicuous places where they are brought directly under the notice of the public. Others incorporate them in business circulars, reports and bulletins. In these and other ways this service obtains publicity to an extent so large as to be most gratifying, especially when the small cost is taken into consideration.

In addition to this cable service every opportunity is taken of bringing before the public any matters concerning Canada which are of general interest in Great Britain, and which relate to the agricultural or industrial development of the Dominion. Bulletins based on official information (such, for instance, as the Census and Statistics Monthly of the Department of Agriculture) are also made public in the same way, and very satisfactory results have been obtained.

An important subject which has been referred to in previous reports is the action of some magistrates in discharging convicted prisoners on the understanding that their relatives or friends would send them to Canada. This matter has been vigorously and persistently taken up with the authorities and others in Great Britain, and I am glad to be able to report that in the year now under review such cases have almost ceased, but should any further arise they will be promptly taken up and dealt with as circumstances may require.

During the year 1908 several cases arose in which persons complained of what they claimed to be wrongful deportation. From time to time such complaints have received publicity in the press; and, in addition, the aggrieved parties have communicated with the High Commissioner, or have brought their grievances before public men in this country. It has been a source of satisfaction to me to receive assurances that the provisions of the Act are administered most carefully, and that everything possible is done to treat those who are so unfortunate as to come under its operations with due consideration.

The relief of Canadians who, from one reason or another, become destitute in Europe is a matter to which this Department devotes much consideration during the course of the year. The fund appropriated by parliament for this purpose is a very small one, and needs careful distribution in order to meet the demands made upon it. During the past year ninety persons applied for assistance. For twenty-eight of these return passages to Canada were procured, and of the balance fifty-one were provided with temporary subsistence money, or lodging or clothing. With regard to the remaining eleven persons, the conclusion was arrived at, after careful investigation of the claims presented, that they did not warrant the extension of any government aid.

Assistance to distressed Canadians has also been extended by the British Consuls at various foreign points. In such cases it is the custom to act as far as practicable upon their recommendations, and to honour any claims they may make for expenditures. The service rendered by His Britannic Majesty's Consuls to Canadian subjects is one that is much appreciated.

With the recurrence of prosperity in Canada there is every reason to hope that the volume of emigration for many years to come, subject to periodic fluctuations imposed by the economic situation, will be well maintained. At the same time sight must not be lost of the important fact of the marked tendency on the part of those European governments under whose jurisdiction are those large emigration areas whence great numbers have migrated to North America to adopt measures making for retention of their populations.

I am, sir,

Your obedient servant,

STRATHCONA,
High Commissioner.

SUMMARY REPORT

OF THE

GEOLOGICAL SURVEY BRANCH

OF THE

DEPARTMENT OF MINES

FOR THE CALENDAR YEAR

1909

PRINTED BY ORDER OF PARLIAMENT

OTTAWA
PRINTED BY C. H. PARMELEE, PRINTER TO THE KING'S MOST EXCELLENT MAJESTY
1910

[No. 26—1910.] [No. 1120.]

To His Excellency the Right Honourable Sir Albert Henry George, Earl Grey, Viscount Howick, Baron Grey of Howick, a Baronet, G.C.M.G., &c., &c., &c., Governor General of Canada.

May it Please Your Excellency,—

The undersigned has the honour to lay before Your Excellency, in compliance with 6-7 Edward VII., chapter 29, section 18, the Summary Report of the operations of the Geological Survey during the calendar year 1909.

WILLIAM TEMPLEMAN,
Minister of Mines.

To the Hon. William Templeman, M.P.,
Minister of Mines,
Ottawa.

Sir,—I have the honour to transmit, herewith, my summary report of the operations of the Geological Survey for the calendar year 1909: which includes the reports of the various officials on the work accomplished by them.

I have the honour to be, Sir,
Your obedient servant,

(Signed) R. W. BROCK,
Director Geological Survey.

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SUMMARY REPORT

OF THE

GEOLOGICAL SURVEY BRANCH

OF THE

DEPARTMENT OF MINES

FOR THE CALENDAR YEAR 1909.

To the Hon. William Templeman, M.P.,
Minister of Mines.

Sir,—I have the honour to submit, herewith, a summary report on the operations of the Geological Survey for the calendar year 1909.

The Survey lost through death two of the oldest and most widely known members of its staff, Dr. J. F. Whiteaves, Assistant Director. Palæontologist and Zoologist, and Mr. Hugh Fletcher, geologist.

Dr. Whiteaves had been connected with the Survey since 1875, during which time he had charge of the Palæontological division. He accomplished a vast amount of work, as shown by the voluminous literature to his credit published by the Survey. He was one of the last of the old corps of palæontologists that included brilliant scientists of almost every civilized country, and that during the latter half of the nineteenth century did so much to advance the sciences of geology and palæontology.

Mr. Fletcher joined the staff in 1872, and since 1875 has had charge of geological investigations in Nova Scotia. For more than thirty years he has been an authority on Nova Scotia geology. His work was marked by painstaking care and accuracy. His industry is shown by the number of maps credited to him, nine small scale and sixty-five of our standard maps of the Province having been made by him, and a number of others are now being completed. He was greatly esteemed both on account of his geological knowledge and charm of personality, especially in Nova Scotia, where he was best known.

The present organization of the Survey is as under:—

Administrative and General.—1 director; 1 secretary; 1 resident caretaker; 2 publication clerks; 2 stenographers; 1 messenger; 1 nightwatch; 3 firewatches; 1 cabinetmaker and carpenter.

Geological Division.—11 geologists; 6 assistant geologists; 1 compiler.

Palæontological Division.—1 vertebrate palæontologist; 1 invertebrate palæontologist; 1 assistant palæontologist.

Mineralogical Division.—1 mineralogist and curator; 1 assistant curator; 1 collector and distributor.

Topographical Division.—1 topographer; 3 assistant topographers; 1 custodian of instruments.

Natural History Division.—1 botanist and naturalist; 1 assistant botanist and naturalist; 1 stenographer; 2 taxidermists.

Draughting Division.—1 geographer and chief draughtsman; 11 draughtsmen; 1 clerk.

Library.—1 librarian; 1 assistant.

One geologist, a geological compiler, two draughtsmen, and a library assistant were appointed during the year.

This staff is too weak, numerically, to begin to cope with even the most pressing work in a country that is so extensive as Canada and that is so rapidly being opened up. To overcome this in some degree, outside assistance is engaged for geological, topographical, and ethnological field work. Foreign specialists, especially those of the United States, give invaluable aid in determining special collections of natural history or palæontological material.

But the official staff must be strengthened to meet the growing needs, especially in those divisions that are relatively weakest, such as the topographical and palæontological. Since Dr. Whiteaves' death all the palæontological work has devolved upon Mr. Lambe. The geological division, which may be taken as representing the effective 'fighting strength' of the Survey, must, of course, be added to; at present it is scarcely larger than that assigned by the United States Geological Survey to work in Alaska alone. Still it is relatively over-large for the topographical division, which should be strong enough to keep it supplied with base maps. Until the topographical division has been brought up to such a strength, thoroughly satisfactory work can not be done. To do this is not merely a matter of funds; in fact, the greatest difficulty is in securing the right type of qualified men. A number of young men are now in training for both the topographical and geological divisions. When the Survey is installed in the new Museum building, additional museum assistants will be necessary, and in particular a trained, scientific ethnologist must be added to the staff to take charge of the Hall of Ethnology and Archæology.

FIELD WORK.

The distribution of field parties during the past season was as follows:—

Yukon and Mackenzie.

Mr. D. D. Cairnes spent the season on the Wheaton river, near Whitehorse, Yukon Territory. Mr. Cairnes discovered some coal seams in this district which may prove important. The district is extensively mineralized. Mr. Cairnes also visited certain

quartz veins east of Whitehorse, and some copper deposits recently found on Williams and Merritt creeks near Yukon Crossing.

Mr. V. S. Stefansson, who is on the *Arctic* near the mouth of the Mackenzie river, is continuing his researches, and will again winter in the north.

British Columbia.

Mr. W. W. Leach was engaged along the Grand Trunk Pacific near Hazelton. Mr. Leach reports that the most important developments of the year are the opening up of several very promising silver-lead veins.

Mr. R. G. McConnell completed his geological survey of Texada island, and made a brief reconnaissance survey of the principal mineral districts of Moresby island, Queen Charlotte group. The ore bodies so far discovered on the latter warrant further and more energetic development.

Mr. F. H. MacLaren completed the topographical map of Texada island, and several large scale maps of the chief mining camps.

Mr. C. H. Clapp continued his geological reconnaissance in the southern part of Vancouver island. The season was spent on the southwest end between Point Nopoint and Alberni canal.

Mr. J. A. Allan, under Mr. Clapp's supervision, spent the season studying the metamorphic rocks between Cowichan harbour and Ladysmith, on Vancouver island.

Mr. R. H. Chapman was in charge of several parties engaged in topographic mapping on the south end of Vancouver island.

Mr. John Macoun and Mr. C. H. Young were again on Vancouver island completing their collection of its flora and fauna for the Museum. Mr. Wm. Spreadborough acted as assistant.

Mr. Chas. Camsell continued his geological survey of the Tulameen district. This little known district is remarkable for the variety of economic minerals found within its borders. Platinum, gold, silver, copper, lead, iron, chromite, molybdenite, asbestos, and coal are reported.

Mr. R. L. Reinecke completed the topographic map of the Tulameen district, and commenced a topographical and geological survey of the Beaverdell district, West Fork of the Kettle river, which, since 1899, has been an important prospective mining camp. Although unprovided with transportation facilities, considerable ore shipments have been made.

Mr. G. Malloch was engaged in reconnaissance work along the line of the Grand Trunk Pacific railway between Tête Jaune Cache and Fort George.

Mr. W. H. Boyd was in charge of a topographical party, mapping the Slocan district on a large scale.

Mr. O. E. Leroy was engaged in detailed economic geological work in the Slocan. This work, it is hoped, will have some influence in bringing about the reopening of properties, now idle, that should be producing, and in reviving interest in what was, a few years ago, the most important silver and lead district in Canada.

Mr. S. J. Schofield was engaged in topographic and geological work in East Kootenay, principally north of the Crows Nest Pass railway, and on the St. Mary

river. Copper and lead-zinc ores are found. The exploitation of the former up to the present has been attended with small success, but the lead zinc prospects are more promising.

Alberta.

Mr. D. B. Dowling, who discovered the Bighorn coal basin in 1906, extended his explorations northward this season. A new coal basin was found, reaching north from the Saskatchewan to the sources of McLeod river, a distance of over sixty miles. A coal-bearing horizon of a smaller area, east of the Bighorn range, was also located.

Saskatchewan.

Mr. W. McInnes explored the country in the neighbourhood of Lac La Ronge, including Nemeiben lake to the west, Wapawekka lake to the east, and a portion of Churchill river to the north, for the purpose of ascertaining the value of the reported mineral discoveries in this district. Unfortunately he was not able to report favourably upon the metallic minerals. The non-metallic deposits of lignite, glass sand, and magnesian limestone are, however, of economic interest.

Ontario.

Mr. W. Malcolm spent a few weeks collecting data in the oil fields of southwestern Ontario.

Mr. W. A. Johnston continued his geological and topographical work in the Lake Simcoe region. Mr. Owen O'Sullivan assisted in the topographic work by surveying control lines.

Mr. T. B. Taylor, who was engaged last year in extending his studies of the superficial geology of the Great Lakes region from the United States into Ontario, continued his work in Ontario during a portion of the past season.

Mr. W. H. Collins extended his surveys in northeastern Ontario, making reconnaissance surveys in the neighbourhood of Florence lake, and the district about Gowganda. Messrs. Burroughs and Rogers, of the Bureau of Mines, Ontario, made a detailed survey of the six townships centreing about Gowganda lake, viz., Van Hise, Haultain, Milner, Nicol, Leith, and Charters. Mr. Collins' task was to secure the information concerning the outlying regions necessary to complete a map covering about 900 square miles, which includes Elk, Silver, Miller, and Gowganda lakes, and Maple mountain. With the area covered by the Bureau of Mines, this has been accomplished.

Quebec.

Mr. Morley E. Wilson was engaged in continuing his surveys north of Lake Timiskaming, near the interprovincial boundary line, in Ontario and Quebec. The area covered includes Larder lake and Opasatika lake.

Mr. J. A. Dresser resumed his investigations in the asbestos regions of Quebec. Some interesting and important observations regarding the distribution of asbestos in the serpentines will be found in his report on the season's operations.

Maritime Provinces.

Mr. R. W. Ells continued his investigation of the oil-shales of eastern Canada. Gaspé (Quebec), New Brunswick, and Nova Scotia shales were examined as to extent and economic value.

Mr. G. A. Young was occupied in topographical and geological surveys in the district about and south of Bathurst, N.B. This was a continuation of the work of last season.

Mr. L. Lambe and Mr. W. J. Wilson each spent a few weeks in collecting palæontological material from southern New Brunswick.

Mr. Hugh Fletcher returned to his investigations in the northern portion of Cumberland county, N.S., which were carried on until the middle of September, when he was seized with an illness that proved fatal. Mr. R. W. Ells has compiled a report from his journal.

Mr. E. R. Faribault continued his geological mapping in the southern portion of Lunenburg county. In December he returned to Nova Scotia to examine recently found tungsten veins near Moose river.

Dr. H. Ries spent the summer investigating the clays and shales of Nova Scotia, as to their extent and economic value.

Mr. J. Keele co-operated with Dr. Ries in these investigations.

Boring.

The boring operations on Prince Edward Island commenced last year were continued during the present year.

SPECIAL FEATURES OF THE WORK.

The work of the Survey is not spectacular. It is close, tedious mapping, working out geological structures, investigating economic possibilities, and in other ways securing and making known the geological information required by the prospector and miner, to enable him to intelligently direct his energy in locating and opening up deposits of economic minerals. This year, as last, almost all of the work undertaken by the Survey has been along strictly economic lines.

It must not be thought that the geologists of the Survey are engaged in prospecting. Such is not the business of the Survey. Prospecting is entirely different work, and should, and has to be left to the private individual. The government geologist may recognize and direct attention to mineralized districts that afford promising ground for prospecting, and furnish information regarding the geological conditions, and mode of occurrence of minerals, that will form serviceable guides to the prospector; but only rarely can a geologist, engaged in his legitimate work, actually discover important bodies of economic minerals. His work in unprospected areas must be too general for this, and where detailed work is undertaken, it is in mining camps where prospecting has already been done. Yet important discoveries are to be credited to officials of the Survey. During the past season it will be noted that Mr. Cairnes discovered a new occurrence of coal in the Whitehorse district, and Mr. Dowling found a new and apparently important coal basin in Alberta.

But quite as valuable are the normal results of the investigations of the field officers. For instance, Mr. LeRoy's work in the Slocan will stimulate mining in this district, and assist in the discovery of new ore bodies; Mr. Dresser has observed facts regarding the occurrence of asbestos that will afford a valuable clue in prospecting for this important mineral.

The scientific investigation of the clays of the Maritime provinces by Dr. H. Ries, Professor of Economic Geology, Cornell University, and Mr. J. Keele, is the beginning of an important series of studies which it is hoped may be extended to cover the settled portions of the whole Dominion. The clay industry of a well developed country forms one of its principal industries, both as regards the value of the output and the number of men employed. In inaugurating this work the Survey was fortunate in securing the services of Dr. Ries, the most experienced authority in America on the subject.

Negative results are, in their way, quite as valuable as positive. All areas do not prove to be promising, and the negative results obtained in such are as important in discouraging the waste of capital and energy, as the positive results in others are in attracting capital and directing its employment.

COMMITTEES.

The geological and map committees which were formed last year to critically consider reports and maps, and to act as advisory bodies in connexion with matters pertaining thereto, have fully justified their formation, by the results already attained. Much has been accomplished toward improving and standardizing the work done by the Survey. The Geological Committee consists of Messrs. McConnell, McInnes, LeRoy, and Young (Secretary); the Map Committee of Messrs. Dowling, Boyd, Senecal, and Dickison (Secretary). The Director is an ex-officio member of both committees.

A great deal of important work falls upon the members of these committees, and especially upon the secretaries, of such a nature that public credit cannot be given for it. It is, therefore, but fitting that attention should be called to it in this place, and that it should be stated that the improvements to be noticed in the most recent reports and maps are to be attributed to the work of the members of these committees.

TOPOGRAPHICAL DIVISION.

The most practical and convenient method of presenting known geological facts regarding a district is graphically, by means of maps. For this purpose, if the geology has been done in detail, accurate contoured topographical maps are essential as base maps upon which to lay down the geological data. Topographical maps sufficiently accurate for this purpose are accurate enough for all ordinary engineering uses. Moreover, when a district is being surveyed for one purpose, economy demands that it should be done with such accuracy that the topographical base map will serve, indefinitely, all purposes that a map on such a scale can be used for. Such maps are now being made by the Survey, in so far as is possible with the present topographical staff.

But this staff is yet too small to meet the present requirements of the geologists. To assist the topographer in charge of this division in organizing and in training a corps of topographers, the United States Geological Survey generously loaned the services of one of their topographers, Mr. R. H. Chapman, to the Canadian Geological Survey.

MUSEUM.

Mr. Broadbent was sent to British Columbia early in the year to collect mineral specimens for the new Museum. These were exhibited at the Alaska-Yukon-Pacific Exhibition in Seattle. While not entered in competition, it was universally conceded that they formed the best and most attractive mineral display at the Exposition.

Valuable collections of natural history, ethnological, and geological material were also acquired during the year.

Special mention may be made of the beautiful collection of sea fauna from Vancouver island, made by Mr. Macoun and his assistants, and skillfully preserved by Mr. Young.

In addition to securing fresh material for the new Museum, progress was made by Mr. R. A. A. Johnston, curator, in preparing the present collections for moving. The ethnological collections were packed up, and the labelling and cataloguing of the palæontological collection are in progress, under the supervision of Mr. Lambe.

PUBLICATIONS.

To be effective, the information collected and published by the Survey must be placed in the hands of those who will find it useful. Every effort is being made to attain this end. The newspapers are informed of Survey publications by means of bulletins issued from time to time. Those who may wish to keep in touch with the publications of the Survey may have their names placed on the notice list, and they will then be advised as to what is appearing. Individual reports as issued are sent free of cost to Canadians interested in them, upon application to the Director.

The increased demand for publications has necessitated the printing of larger editions. For the convenience of libraries and of authors referring to publications, it has been decided to call the reports 'Memoirs,' and to number these consecutively as Memoir No. 1, Memoir No. 2, etc. Similarly the maps will receive their own consecutive numbers, as Map No. 1 A, etc. This change will come into force the beginning of the new year.

It may be mentioned that the recent maps and those hereafter to be published may be obtained printed on linen for field use. An extra charge of ten cents is made for maps on linen.

SPECIAL PUBLICATIONS.

The work and publications of the Survey add year by year to the knowledge of the minerals and geology of the country. Important facts are liable to become buried under the accumulating mass of detail, reports get out of print, and the literature becomes too voluminous to be readily accessible. It has, therefore, become important to cor-

relate and compile the information on a particular subject into one handy volume for reference. A beginning has been made in this during the past year. An official has been appointed to devote his whole time to the work. With Mr. Faribault, he has been compiling all the information on the gold-bearing rocks of Nova Scotia. This report will soon be ready for the press. A Descriptive Sketch of the Geology and Economic Minerals of Canada, compiled by the Director and Mr. Young, with the aid of other members of the staff, has just appeared; also a compilation of the information on the coals of the Northwest provinces by Mr. Dowling. Similarly, the Natural History division has issued a Catalogue of Canadian Birds, that brings the information on this subject up to date in a handy and readable form.

Other compilations will be undertaken as rapidly as can be done without interfering with the regular investigations, which cannot be curtailed.

EDUCATIONAL COLLECTIONS OF ROCKS AND MINERALS.

The number of mineral collections distributed to colleges and high schools during the past year has far exceeded that of any previous one: nearly 23,000 specimens have been sent out.

The materials for these are collected by Mr. A. T. McKinnon, who also prepares and makes up the collections. Great praise is due this official for his industry and interest in the work, and to Mr. R. A. A. Johnston, who has general supervision over it, for the completeness and attractiveness of the collections.

ETHNOLOGY AND ARCHÆOLOGY.

An investigation of the Esquimo of the Arctic, near the mouth of the Mackenzie, was undertaken last year by Mr. V. Stefansson, under the joint auspices of the American History of Natural History and the Geological Survey, and a preliminary report was published in last year's summary.

Mr. Stefansson is still in the north. Last August he was working eastward, and had reached Cape Bathurst. After studying the Baillie Islanders, he intended to proceed to the Coppermine, and winter there with the Esquimo. The winter of 1910-11, if all goes well, will be spent in Victoria Land. His report for 1909 has not yet reached Ottawa.

When the collections are moved to the new building, a scientific, trained ethnologist will have to be appointed to take charge of the collections in the Ethnological Hall, and to direct work in connexion with ethnological and archæological investigations. As pointed out in last year's summary, this work must be undertaken at once or it will be too late, for the materials will be lost forever, and future generations of Canadians will be unable to obtain reliable data concerning the native races of their country.

It is gratifying to note that public opinion is awakening to the urgency, importance, and value of this work. A strong resolution has been received from the Winnipeg meeting of the British Association, urging that steps should at once be taken in this direction. The Archæological Society of America, which has a strong Canadian department, and the Royal Society of Canada, are also interesting themselves in this

matter, so that the time seems opportune to begin serious and systematic work in Canadian ethnology and archæology. The results obtained will be greatly increased by the friendly co-operation of all who may be interested in these subjects.

WORK OF THE DIRECTOR.

Routine executive work occupied the greater portion of the year.

In January, I attended the Baltimore meetings of the Geological Society of America, and the American Association for the Advancement of Science. From Baltimore I went to Washington, where a conference of the directors of Federal and State Geological Surveys was held. A few days were spent in visiting the National Museum, and in becoming familiar with the administrative system in force in the United States Geological Survey. Returning, a day was spent in New York, at the American Museum of Natural History, in investigating distinctive features of this Museum.

The March meeting of the Canadian Mining Institute in Montreal was attended, as were various meetings of council held throughout the year.

On June 25, I left for Prince Edward Island, to select a site for the final bore-hole to be drilled by the Department in investigating the coal possibilities of the island. From Prince Edward Island, I crossed to Nova Scotia, intending to visit some of the mines, and to look over interesting geological areas in company with Mr. Fletcher; but owing to illness I was compelled to return to Ottawa.

On being released from the hospital, I left for British Columbia.

BRITISH COLUMBIA.

On July 27, I reached Victoria, and visited the Geological Survey party at work in this vicinity.

On the 28th, I joined the Hon. William Templeman, Minister of Mines, on an official visit to the mining camps along the west coast of British Columbia and in the Yukon.

As I was under physician's orders to refrain from any physical exertion for three months, I could not visit any point not accessible by conveyance, consequently for many mines in many districts visited, information could not be secured by personal investigation, as will appear from the following notes, but had to be gained through mining men familiar with the district, who kindly furnished specimens and descriptions.

In the immediate neighbourhood of Prince Rupert, the known economic minerals are: clay, near Iroquois, on Skeena river, which burns to a good brick; and limestone, on Smith island, which is being utilized for lime. It is said to be of excellent quality. At Prince Rupert, Lieut. P. C. Musgrave met us with the Hydrographic Survey's steamer *Lillooet*, on which we visited Portland canal and Queen Charlotte islands.

Portland Canal.

Portland canal is the most northerly inlet on the Canadian coast, and forms part of the boundary line between British Columbia and Alaska. Its length is a little less

than 60 miles. About 10 miles up, Observatory inlet branches off. At the head of Portland canal, on a flat at the mouth of Bear river, the new mining camp of Stewart is being established. The claims are situated on Bear river and its tributaries, commencing about four miles up from tidewater at Stewart.

In 1899 the first claim (Roosevelt) was staked on Bitter creek, a tributary of Bear river, by a prospector, who had gone into the head of Nass river by way of Portland canal and Bear river. In 1902, Stewart's claim, on American creek, was staked. In 1903, a Deputy Mining Recorder's office was established, and in that and the following year some locations were made. In 1905 and 1906, the principal claims on Glacier creek were staked. In 1906, Mr. H. Carmichael, Provincial Assayer, made a report for the Provincial Mineralogist on this district. He visited it again this summer, and his report[1] describing the best known claims has been issued by the Provincial Bureau of Mines. In 1905, Mr. Fred Wright, while engaged in work for the United States Geological Survey in Alaska, made a geological examination of the upper part of Unuk river, which is in British Columbia, about 40 miles north of Stewart. His report on this section was kindly given to the Canadian Geological Survey, and was published in the Summary Report for 1905. As Bear river appears to belong to the same geological province, this report is of direct interest to miners and prospectors in Stewart.

The country is of the character which has become recognized as typical of southeastern Alaska. The valley occupied by Portland canal and Bear river is about a mile wide, flanked on either side by somewhat precipitous mountains rising to a height of about 5,000 feet, with an occasional peak 1,000 or 2,000 feet higher. The canal is navigable to its head for boats of deep draught. Almost at the head of the canal Salmon river enters from the Alaska side, and between it and Bear river is a mountain ridge which the International Boundary follows for some distance.

Bear river has a gentle slope for the first 10 miles, giving an easy gradient for a road, beyond which it is said to rise more rapidly. Glacier creek enters it from the east about 4 miles from the mouth, and Bitter creek about 8 miles up, while American creek enters from the north, about 12 miles up. The majority of the well known claims are on Glacier creek and American creek.

The camp lies in a metamorphic zone along what is probably the eastern limit of the Coast Range granite. The granite forms a long and relatively narrow belt along and near the coast, extending from the Fraser river to the White River basin in the Yukon, a distance of 1,100 miles. Its width is from 30 to 60 miles. This huge body of granite, known as the Coast Range batholith, was intruded into the preexistent Palæozoic (?) sediments at some time between upper Jurassic and middle Cretaceous. The sediments near the granite contact are metamorphosed, the degree of metamorphism becoming progressively less intense from the granite contact to the outer limit of its effect. Dikes from the granite network the adjacent schists, and inclusions of the sedimentary rocks are numerous in the granite batholith for some distance from the contact, and are also found in isolated patches, which are remnants of the original roof, now mostly removed by erosion, through which the great intrusive

[1] British Columbia Bureau of Mines, Bulletin No. 1, 1909.

mass of granite has been exposed. This batholith, and its effect on the adjacent country rock, has been described in previous reports[1] of the Geological Survey.

As noted by Wright, the metamorphism of the sediments on the two sides of the Coast Range batholith is dissimilar. On the western contact the slates and argillites are changed to phyllites, mica schists, and, in immediate contact with the granite, frequently to gneiss. The strata are intensely folded, and give evidence of having been deeply buried at the time of metamorphism. Farther west from the contact, the rocks were evidently nearer the surface at the time of the intrusion, and these show more typical contact metamorphism and mineralization. The rocks along the inland contact of the granite are less altered; typical schists and gneisses are rarer; the contact line is more clearly defined; the rocks show contact metamorphism, and near the contact are often heavily mineralized with sulphides. The distinction between deep-seated metamorphism and contact metamorphism has here great economic importance, for in the former, conditions preclude, as a rule, the formation of ore bodies, while in the latter they frequently favour it.

The most promising rocks to prospect then, are those showing contact metamorphism, and in northern British Columbia, at least, the inland border of the granite is most likely to present this phenomenon, though it also occurs at a number of points along the coastal border. It must be understood that when the contact of the granite is recommended as a point to prospect, the immediate contact is not specially meant, but rather the bordering zone influenced by the intrusion.

Throughout its entire length, wherever the invaded, contact-metamorphosed rocks are exposed along the borders of the Coast Range batholith or occur as large inclusions in it, they will probably be found attractive to the prospector. Such areas are found in the Bear River camp, in the Unuk River district, 40 miles north, and probably in the country between. The geological examination of this field will probably show that the ore bodies owe their origin to the intrusion of the granite.

As it was not possible to visit the claims, little can be said about them. Two classes of ore were exhibited at Stewart: quartzose ore, carrying silver, gold, and lead values, and a pyritic copper-gold ore. The persistence of the veins is noted by all, a succession of claims being located on what is said to be the same vein, traceable throughout. The quartzose ore contains galena, sometimes blende, and silver minerals such as argentite, and native silver. Pyrite is sometimes plentiful. The copper ore consists essentially of pyrite and chalcopyrite.

The Portland Canal Mining Company, on Glacier creek, operating on a vein carrying gold-silver-lead values, has done the greatest amount of work. This is the first Company to put in an aerial tram. and concentrator. The latter will have a capacity of about 50 tons per day.

The Stewart Mining and Development Company ranks next in development work. The ore is somewhat similar.

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[1] Dawson, G. M.—The Yukon Dist., Vol. III, Part I. B., 1887-8, and Report on an Expedition from Port Simpson to Edmonton, 1879-80 B.
Wright, F. E.—The Unuk River Mining Region, Summary Report, 1905.
LeRoy, O. E.—Preliminary Report on a Portion of the Main Coast of British Columbia, Nanaimo and New Westminster Districts, Geol. Surv. Publication 996.
Bancroft, J. A.—Powell River to Kingcome Inlet, Summary Report, 1907.
Graham, R. P. D.—Geology of the Coast from Kingcome Inlet to Dean Channel. Summary Report, 1908.

The ore of the Red Cliff, on American creek, is a copper-gold one. Specimens from it look very promising, and the body is said to be large. A compressor plant is to be installed at this property.

Other properties well spoken of include the American Girl group and Montrose, on American creek; Pasco and Independence, and Tyee, on Bear river; and the Little Wonder, Lake View, O.K., Fraction, Jumbo, Apex, Cook and Dobson, and Matheson claims on Glacier creek.

Wharves are to be constructed, and arrangements have been made by men interested in Mackenzie, Mann & Company, Limited, and in the Canadian Northern Railway Company, to build the 'Portland Canal Short Line railway' from Portland canal up Bear river for a distance of 15 miles. Construction will be started as soon as the snow leaves in the spring, and it is expected that the road will be in operation during the summer. These gentlemen are also directly interested in mining in the district, having bonded some properties on Bear river.

The Hidden Creek Copper Company mine at Goose bay, Observatory inlet, is being actively developed. It is reported to have large bodies of pyrite and chalcopyrite, carrying 3 per cent to 6 per cent copper, with $1 to $3 in gold and silver. An 8 drill compressor, driven by water-power, has been installed, and plans have been made for a tram and electric railway for transporting the ore to tidewater.

Queen Charlotte Islands.

Returning to Prince Rupert from Stewart, we proceeded to Queen Charlotte islands, stopping at Ikeda bay, Collison bay, Jedway, Lockeport, Skidegate, and Queen Charlotte. For a description of the ore deposits, the reader is referred to Mr. McConnell's report on page 72.

Although the occurrence of iron, copper, and coal on Queen Charlotte islands has been widely known since the publication of Dawson's report[1] in 1878, their isolated position has prevented interest being taken in the islands. With the building of the Grand Trunk Pacific railway, and the founding of Prince Rupert, conditions are changed. The islands are now easily accessible, and will share in the attention which will be devoted to the development of the northern coast of British Columbia. The coal measures of Graham island, reported upon by Dawson, and later by Ells,[2] have remained undeveloped, but this summer were being tested by prospective purchasers. If the tests are satisfactory, a large coal industry is assured, for the measures are admirably situated to supply the northern trade, which will soon be important.

Little development of a decisive character has yet been done on the ores, but the Ikeda mine has demonstrated that at one point, at least, mineral is concentrated in commercial ore bodies. At Klunkwoi bay chalcopyrite and bornite are disseminated throughout a diabase rock over wide areas, the copper in certain areas running ½ per cent to perhaps, in places, 2 per cent, according to McConnell's report. It would seem worth while to try concentration on this material.

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[1] Annual Report of the Geological Survey, 1878-9. Report on Queen Charlotte islands. G. M. Dawson.

[2] Graham Island Coal Fields. R. W. Ells, Vol. XVI, 1904, Geological Survey Reports.

Atlin District.

We returned to Port Essington and Prince Rupert, and left the latter on August 9 for Atlin, where some large scale operations with the aid of machinery are in progress. Here we visited Pine and Spruce creeks. On Pine creek, hydraulic mining is being done, and a dredge is under construction. At Discovery, Mr. Refener is operating three pits, each with its battery of monitors. The monitors are used for piling the tailings, as well as for cutting down the banks and feeding the sluice boxes. The yellow, gold-bearing gravels underlie a hard, barren, bluish, glacial boulder-clay, 30 to 40 feet thick in places. This adds to the difficulty of hydraulicing, as its hardness necessitates bulldozing the blocks into which it breaks from the faces. Dynamite is also used to some extent to bring down the banks.

On Spruce creek, individual miners are working bench claims. Most of these are operated on 'lays,' the lessee paying a royalty of 20 per cent or upwards to the owners. Inclines are sunk to bed-rock, and drifts run on the pay gravel. Overshot wooden water wheels are used for hoisting.

The most interesting feature in connexion with mining in the Atlin district is the reported lode discoveries. Unfortunately it was impossible at the time for me to visit them, but from specimens seen and from the descriptions given of the occurrences, they would seem to be promising. They embrace gold, silver, lead, and copper. Taku Arm is staked from near Golden Gate to Jim creek. On the Engineer group, Taku Arm, a wide, gold-bearing ledge occurs, with a second parallel ledge; stringers of quartz rich in gold accompany them. Specimens, said to be from this property, were rich in free gold. Stibnite also occurs. It is reported that samples selected during two months by two men and sent to an assayer netted $1,800. Ore, said to come from Lavdierere claim, Hobo creek, 3 miles from West bay, contained native copper, cuprite, copper glance, chalcopyrite, and magnetite. There is reported to be a large body of low grade ore with high grade streaks. A strike of rich ore on Jim creek, carrying gold, silver, and lead, is reported. On Fourth of July creek there are reported to be solid bodies of argentiferous lead.

Very little prospecting or developing is being done, but this does not necessarily mean that the showings are not as promising as reported, for the high cost of labour and supplies makes it impossible for the ordinary prospector to operate. Mr. J. C. Gwillim, who reported upon this district in 1901,[1] states that 'some of the deposits show sign of strength and probable permanence. The cost of development at present is heavy. Transportation rates added to this make a heavy total for the production of refractory or smelting ores. Such ores are found to some extent in this district, more especially to the north of Pine valley, in the actinolite slates, and in one instance in granite, on Crater creek, a tributary of Fourth of July, there are veins of gold-bearing quartz. Some of these deposits are strong, well defined lodes, usually with a gangue of quartz. Sulphides of iron, lead, and copper are present. As far as determined, these are not of high enough value in the precious metals to encourage their development during present conditions of heavy costs. Other deposits of more or less free-milling gold-quartz offer better returns for development. In some cases very rich assays are given.' Gwillim mentions a number of leads examined by him. Since his report many

1 Annual Report, Geological Survey, Vol. XII, p. 44 B.

new discoveries have been made and the mineralized areas considerably extended, but the 'conditions of heavy costs' remain practically unchanged, and consequently little has been accomplished toward establishing lode mining.

Hydromagnesite, a precipitate from mineral springs, in the vicinity of Atlin, occurs in some quantity. The bed immediately behind the town covers 2 or 3 acres and is several feet thick. It also occurs on a number of other marshy areas in the neighbourhood. These deposits will be of commercial importance.

Rainy Hollow.

Some interest is being taken in mineral occurrences in the extreme northwestern portion of British Columbia. Very promising specimens of copper-silver-gold ore made up of chalcocite, bornite, and grey copper with a garnetiferous gangue, were exhibited from Rainy Hollow, Klehini river.

YUKON TERRITORY.

Carcross.

The most serious attempts to establish lode mining in this northern section of the Dominion are the operations near Carcross, in what has been termed the Conrad district. A recent report by Mr. D. D. Cairnes[1] describes the district and its ores in detail.

In the time at our disposal, we were able to visit only the Venus and adjoining claims on Windy Arm. A small concentrator has been built on the lake shore, connected with the mine, 900 feet above it, by an aerial tram. About 3,000 feet of development work has been done, consisting principally of a cross-cut tunnel of 600 feet to the vein, and drifts on the vein 500 feet long on each side of the cross-cut. At the ends of the drift are winzes, 150 and 180 feet deep respectively. There is also a raise to the surface. The vein, which is very persistent, varies from 1½ to 4 or 5 feet in width. It is oxidized for about 350 feet below the surface. The oxidized ore is said to run about $10 in gold and $10 in silver. Below the zone of oxidization the gold value is reported to be higher. The vein, angling down toward the lake, may be traced on the surface westward for several claims. An aerial tram connects the Vault to the lake, and another connects the Montana with Conrad. Other claims on which considerable work has been done are the Thistle, Aurora, and Pelly. The Venus and adjoining claims were being operated at the time of our visit.

The chief interest at present in this section centres in the developments at the Big Thing, about five miles from Carcross. I was not able to get out to this property. The vein is said to run from 5 to 16 feet in width, and to carry a quartz-arsenical-gold ore of good grade. A shaft has been sunk at an angle of about 45°, to a reported depth of about 610 feet. It is said to be the intention to tap the vein by a cross-cut tunnel, from the mouth of which an aerial tram will carry the ore to the railway.

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[1] 'Report on the Conrad District,' by D. D. Cairnes, Geological Survey. No. 982.

Whitehorse.

A day was spent at Whitehorse visiting the copper claims in the vicinity. These deposits are of the contact metamorphic type, like the Boundary Creek and Texada Island deposits. They have been described by Mr. R. G. McConnell in a recently published report.[1]

Concerning the three best developed iron ore bodies, Mr. McConnell estimates the tonnages that may be considered assured as follows:—

PUEBLO.

'The Pueblo ore body consists of an impure mass of hematite, 300 feet in length, with a maximum width of 170 feet. The surface section measures approximately 33,000 square feet. The ore body has been proven to a depth of 100 feet, and at 70 feet a drift of 120 feet failed to cross the lode.

'Assuming that the ore body carries its surface size down to the bottom of the shaft, it would contain 3,300,000 cubic feet of ore above that level. The weight per cubic foot is not definitely known, as the hematite is intermixed with various impurities such as garnet, epidote, quartz, calcite, etc.; but probably averages about 8 cubic feet per ton. This would give a tonnage of 412,500 above the 100 foot level. It is probable that the lode extends some distance below the 100 foot level, and a considerable additional tonnage might safely be added.

'Copper contents probably average 3 per cent. Gold and silver values are small, about $1.'

BEST CHANCE.

'The ore body is a mass of magnetite, 360 feet long with a maximum width of 65 feet. The surface section measures approximately 13,120 square feet.

'The workings are shallow, and have not proved the deposit to a greater depth than 35 feet. In addition to this the lode projects 15 to 20 feet above the surface. A total depth of 50 feet represents the proved portion of the lode at present. With a depth of 50 feet the lode contains 656,000 cubic feet of magnetite, weighing, at 8 feet per ton, 82,000 tons.

'The grade of the ore in copper is about 3 per cent. The gold and silver values are small.

'The probable tonnage is at least double of that given.'

ARCTIC CHIEF.

'The Arctic Chief ore body on the main level, 65 feet below the surface, has a length of 190 feet and an average width of 30 feet, the section measuring 5,700 square feet. A shaft from the main level proved ore for a further distance of 25 feet, or a total distance of 90 feet. The surface section is on a slope, and part of the ore body has been removed by erosion. Assuming 80 feet as the average depth of the lode, the contents measure 456,000 cubic feet, weighing, at 8 feet to the ton, 57,000 tons.

[1] Report on Whitehorse Copper Belt. Geol. Survey, Pub. No. 1050.

'Average copper contents.. .. .. 4 per cent.
Average gold.. .. .. $4 per ton.
Average silver.. .. .. 2 ozs. per ton.

'Numerous smaller iron masses and irregular lenses of bornite-chalcopyrite-ore occur throughout the district.'

It is likely that the ore on the Pueblo will extend below the present workings at least 50 feet, so that 250,000 tons might be considered as probable ore for the Pueblo. This would give over 800,000 tons on these three properties alone. But the ore may extend for a considerable distance below the present shallow workings. The experience elsewhere on deposits of this type has usually been that considerably more ore is recovered than has been estimated from limited development work. These deposits, therefore, appear to be already capable of producing an important tonnage, with promising prospects for future developments.

None of these properties were working at the time of our visit. It is reported that a spur from the railway will be completed to the Pueblo in the spring, and that shipments may then be made. Some prospecting was being carried on in the Wheaton River district a few miles to the south of Whitehorse. Low grade copper ores similar to the Whitehorse deposits were found this year at Williams creek, near Yukon Crossing. Concerning these Wheaton River and the Williams Creek prospects, information will be found on a later page in the summary report of Mr. D. D. Cairnes. The Wheaton River district contains silver, lead, gold, and antimony veins of some promise. Mineralization is widespread. Coal similar to that at Whitehorse and Tantalus was found this summer by Mr. Cairnes on Bush mountain. The Tantalus coal mine is producing.

Yukon.

Dawson was reached on the night of August 19. The first day was spent in Dawson itself. On August 21, I went 10 miles down the river to see a rock bluff on the east bank which was reported to pan gold. In the afternoon the party visited the dredge operated by Mr. Simpson on Bonanza creek. On August 23, we started to visit the creeks, accompanied by Mr. F. T. Congdon, M.P., and Commissioner Henderson. Mr. Gray, of Dawson, was with the party for a couple of days, and Sheriff Eilbeck for the rest of the time. The district is well supplied with good roads, so that an automobile was used throughout.

We first went up Hunker creek and down Dominion creek to 33 Below, stopping at Peter Rost's, where we witnessed a clean-up. A pan of fine nuggets from new ground on Caribou creek served as an interesting reminder that discoveries of rich ground can still be made. Returning to the summit, the night was spent at the roadhouse. Next morning a stop was made below the Dome to visit the tunnel being run in from Dominion Creek slope, to prospect quartz veins that have been located on the surface. From the tunnel we proceeded to Sulphur creek, and down Sulphur to Granville, where we spent the night. On the 25th we returned to Sulphur, and down Hunker to Dawson. Next day, Bonanza, Eldorado, and Quartz creeks were visited. The night was spent at Quartz, and the following day we proceeded up Quartz to the Dome and down Bonanza to Dawson. The following day I accompanied Mr. A. N. C.

Treadgold to Hunker and Last Chance creeks, and spent the day on the White Channel gravels. On August 29, Mr. Templeman left Dawson for Victoria via Skagway, while I continued down the Yukon, to visit the placer camps of the lower Yukon and Seward peninsula, returning to Victoria via Nome.

PRESENT CONDITIONS.

Gold mining in the Klondike is rapidly changing in character. Individual mining is being superseded by large scale operations, with such engineering and mechanical aids as water led in from a distance, electrical power, mechanical lifts, dredges, etc. The Yukon Gold Company is working on the largest scale, and is about to increase its effective operations. The Yukon ditch has been completed from Twelvemile to Gold hill, a distance of about 70 miles. In its course across country it is alternately ditch, flume, and pipe (the latter as a huge inverted syphon in crossing valleys such as the Klondike). Hillside springs and marshes present difficulties in maintaining the ditch, but it is rapidly becoming 'seasoned' by skillfully applied natural means, and, it is hoped, will soon have the stability of a natural watercourse.

Seven dredges are being operated successfully by this Company and three mechanical lifts. These plants are operated by electricity furnished by the Company's power plant near Little Twelvemile. The main, high-voltage transmission line is 36 miles long, besides which there are 18 miles of branch lines and 8 of secondary lines. In all, ten dredges are working in the Klondike, three on the river itself, five on Bonanza creek and two on Hunker creek.

A very extensive scheme for power development is under way on the Klondike river about 30 miles above Dawson. Water from the North Fork of the Klondike will be utilized to generate power to be transmitted over all the mining district. Individual claims are being rapidly consolidated, usually by purchase, into larger holdings. With a greatly increased number of plants, it will still take years to clean up the gravels of the district. Practically all the worked-over ground and underlying bed-rock will be re-treated by mechanical devices. High-level gravels for which there was no available water, and claims which by reason of mechanical difficulties could not be attacked by the individual miner, will furnish a big additional field for large-scale operation. McConnell, in 1906,[1] estimated future production at about $63,000,000, making no allowance for rich discoveries. The work done since then is said to have shown that this estimate was thoroughly conservative, and that the actual production will be considerably in excess of these figures.

Some attention is being directed to the quartz possibilities of the Klondike, and many claims have been staked. The neighbourhood of the Dome, Goldbottom creek, and Victoria gulch are the localities so far in most favour, but interest is not confined to these. Little work, however, has been done, and no decisive data have yet been obtained.

On the Dome property a tunnel is being driven into the hill from the Dominion Creek slope, with the intention of prospecting several quartz veins which it is expected will be cross-cut between 950 and 2,000 feet. The prospect is equipped with a small

[1] Gold Values in the Klondike High Level Gravels. Geol. Survey Publication, No. 979.

compressor plant, and at the time of our visit the tunnel was in 920 feet. For the first 150 feet the ground is frozen; inside the frost line, the rock is solid Klondike schist. A few slips occur and small quartz veins, also bunches of quartz and calcite. Most of the slips and veins dip into the hill, but a few with it. The movement along the slips appears to have been small. In one instance a slip faulted a 2 inch quartz vein, causing a displacement of about a foot and a half. These small veins give the impression of being persistent. The slips are not very numerous, and the ground inside the frost line is as solid and free from disturbances as in most mineralized areas. Near the surface, in the frost zone, the ground is broken into small blocks which are gradually working downhill. This 'creep' is quite pronounced. Since our visit, it is reported that two ledges have been encountered from which good assays have been obtained.

Near the close of the season, a two-stamp mill on the Lone Star group at the head of Victoria gulch made a test run of over one hundred hours on surface quartz, with results that are said to be entirely satisfactory. McConnell, in his report on the Klondike Gold Fields (p. 65), speaking of these veins says, 'the prospects are certainly encouraging, and warrant further investigation.'

The prospecting on the rock bluff 10 miles below Dawson, and below the Indian village of Moose-hide, shows that attention is not wholly confined to the placer creeks. The bluff consists of coarse, quartz-mica schists, with numerous quartz stringers, a few of which are said to pan gold. But the rock which attracted attention is a basic igneous dike which cuts the schists. On the exposed surface it is rusty-weathering with a marked spheroidal structure. We did not succeed in obtaining colours, but subsequent pannings are reported to have yielded positive results.

As yet there is nothing definite on which to base a judgment regarding the quartz possibilities, but there are facts in connexion with the geology of the district and the occurrence of placer gold, which have a bearing on the question, and furnish at least suggestions with regard to prospecting for quartz. Detailed descriptions of the district may be found in McConnell's Klondike Gold Fields (Geological Survey, No. 884), and his 'Gold Values in the Klondike High Level Gravels' (Geological Survey, No. 979), and need not be repeated here. But the salient points which strike the visitor may be worth mentioning.

GEOLOGICAL HISTORY OF THE KLONDIKE.

The complete geological history of the district is, of course, somewhat more complicated than represented in the following notes. The district is not glaciated, and the present topography is the result of weathering and erosion. Viewed from an eminence, the streams are seen to possess wide valleys with gently sloping sides rising to rounded hills with broad, rather flat tops. Outcropping rocks are conspicuously absent. Broad amphitheatres at the heads of the creeks are characteristic. Rock-waste subdues the outlines of the hills, and deep gravel deposits cover the gently sloping valley bottoms. Here is seen a region in a state of advanced maturity. But rejuvenescence occasioned by a recent uplift is also observable. The Yukon has sawn a trench 700 feet or so into the bottom of the old valley. The Klondike, responding to this lowered base-level, has correspondingly trenched its old bed, and Bonanza and Hunker creeks have chan-

nelled their valleys in harmony with the new Klondike level. The creeks south of the Dome are still in the old channels, for the Indian river has not yet advanced its new cañon as far up as the mouths of these streams.

For a period extending a long distance into the geological past, conditions of weathering, erosion, and deposition have obtained, with no disturbances sufficient to seriously interrupt these processes, to erase their effects or sweep away their products. This fact, brought into notice by the topography of the district, is accentuated by an examination of the gravels themselves. The old valleys, except where covered by recent accumulations or cut into by the rejuvenated streams, are floored with 'White Channel gravels,' which rest on a yellowish, clay-like bed-rock, the weathered, rotted country rock. The 'White Channel gravels' themselves are bleached mixtures, consisting largely of fine sericite and quartz pebbles. Pebbles of country rock have decomposed and fallen to pieces, or if present, disintegrate at a touch. Stratification is gone. Decomposable minerals have broken down. Soluble elements have been leached out, and stable combinations like sericite formed of what remains. Magnetite is practically absent, though originally it must have been plentiful. Only the most resistant minerals, such as quartz and sericite, with some gold, are left. Weathering, therefore, has been an important and long-continued process on the rock surfaces, in the hillside wash, and, finally, in the stream accumulations in the valley bottoms.

The country rock consists of sericite and chloritic schists, with some dark, graphitic argillites cut by some dikes of igneous rocks, quartz porphyries, rhyolites, and andesites. Quartz veins and stringers, some, at least, gold-bearing, are abundant in these schists. Exposures are not numerous, being largely confined to occasional outcrops on the summits or in the cañons of the rejuvenated streams. But the large amount of quartz in the debris which mantles the solid rock evidences the presence of quartz veins where they are not exposed.

The old White Channel gravels, representing a natural concentrate from a great mass of gold-bearing material through long ages, by weathering and stream action, are rich in gold. The gold occurs in a well defined paystreak, as is usually the case in stream gravels. The present stream beds where they have cut down through the White Channel paystreak were enormously rich, as might be expected since they represent a reconcentration of an already rich concentrate. Where the White Channel paystreak was untouched, the present stream bed was apt to prove lean. Going up stream, the gold usually becomes less worn, rougher, more angular, and coarser. The gravels are not always of pay grade to the heads of the creeks nor always to the mouths of the creeks; some of the tributary gulches are rich and some have proved barren. Often gulches which head together are paired as to gold contents. If one is rich the other is rich; if one is poor the other is poor. Gold in the recent gravel freshly derived from its original source is similar to gold in the corresponding White Channel gravel. Many of the gold grains and most of the nuggets, enclose quartz. Quartz pebbles are found containing gold, some at least very rich in gold. The quartz of the boulders is similar to the quartz of the veins, and gold of the veins to the gold of the gravels. From the foregoing and other facts, it is obvious that the gold is absolutely local in origin, derived from the basins of the pay gulches and creeks.

QUARTZ POSSIBILITIES.

The extraordinarily rich gravel represents the concentration of a great mass of gold-bearing material. There are several possibilities regarding the source of the gold. It might be derived from disseminations through the country rock. A gold value of a few cents a ton, such is the volume of country rock weathered and eroded, would more than account for all the millions in the gravels. But this interpretation does not fit the facts. In addition to those above alluded to, it may be recalled that Eureka creek, which is gold-bearing, is not in the Klondike schists at all, but in the Nasina series, which almost everywhere else is unproductive. It is then practically certain that the gold of the gravels has come from the quartz veins. When one considers the extremely local occurrence of the gold, the suggestive form of the nuggets, the overwhelming importance of quartz in the gravel, the widespread occurrence of quartz in the very nuggets themselves, the 'kindly' appearance of the quartz of the pebbles and the actual occurrence of gold in this quartz and also in some of the veins so far uncovered, the numerous veins on the rich creeks, etc., no other view seems at all tenable. But granting this, there still remain several possibilities. The gold may be somewhat uniformly distributed throughout the innumerable quartz stringers and veins, in which case they would almost certainly be too lean for profitable exploitation. The probabilities, however, are that this is not the case, and such facts as are known do not suggest this possibility. To begin with, this is not the usual characteristic of gold-quartz veins. Again, quartz is widespread; gold confined to particular creeks and gulches. Some of the quartz boulders are likely-looking, some very unpromising; suggesting that they are from veins of different origin and contents. Other facts also tend to indicate that the gold is confined to certain veins. The large nuggets and the richness of the gravels at the heads of some of the pay channels would suggest that in the auriferous veins themselves the gold is already concentrated to a certain extent at least. The rich kidney of quartz found on the New Bonanza claim, Victoria gulch, is an example.

Up to this point, the argument is all in favour of the possibilities of rich quartz veins, but here some uncertainties enter. The gold might be concentrated in ore shoots, as is usually the case in veins. These might be large and workable bonanzas or small and pockety. The pay ore may have been largely removed by erosion, and for the most part, only low-grade roots of veins left. Veins, though rich, might be too small or irregular for mining. McConnell admits that most of the veins seen by him were of this character. On the other hand, comparatively few of the veins have been exposed, and it is quite possible that large and regular veins are to be found. So far, developments on the Dome property tend to strengthen this possibility. Moreover, the small veins might occur in groups or zones that collectively might be capable of development, or the country rock in the neighbourhood of a vein might prove sufficiently mineralized to give workable dimensions to the ore body. There is not yet sufficient information available to determine the actual conditions in the Klondike with respect to these last points, so that the future of the lode mining cannot be predicted with certainty. As just shown, the balance of the evidence, so far as it goes, is distinctly favourable, and the stakes are tempting. In my opinion, then, it is well worth while making serious attempts to locate workable quartz.

In this connexion it is interesting to note that prospecting for quartz in the placer camps of Alaska is furnishing encouraging results. Some promising gold-quartz has been found in the Koyukuk and Chandalar regions. At Fairbanks, according to information furnished by A. H. Brooks, of the United States Geological Survey, prospecting for quartz or veins has been carried on at a number of points. Veins varying from less than an inch wide to 12 feet have been found. The rich ore has thus far been confined to stringers or veins under 3 feet thick, but valuable material is reported in places in the adjoining country rock. Though many of the individual stringers pinch out and some of the veins are faulted, others may be followed for several hundred feet. Development work is as yet limited, but the prospects are considered sufficiently encouraging to warrant serious development and further prospecting for quartz veins.

On the Seward peninsula, quartz seems to be receiving greater attention than ever before. This autumn a magazine was started at Nome in the interests of quartz mining on the peninsula. The Big Hurrah mine, in the Solomon River region, has been operated for a number of years, and has the distinction of being the first lode mine on the peninsula. It has a stamp mill, and seems to have demonstrated that in certain spots at least, mineralization is sufficiently concentrated, and veins sufficiently large and continuous, to make a lode mine. Here is one place where a northern placer has developed into a lode mine, and where some of the placer gold has been traced to its source.

NOTES FOR PROSPECTORS.

The prospects for developing lode mines in the Klondike I would consider to be quite as promising as in the lower Yukon. The most attractive prospecting ground is naturally on the creeks which have had rich gravels, for since the gold is local in origin and, presumably, derived from quartz, they indicate the existence of auriferous veins in their basins. Some guidance as to the best points to prospect in the individual basin is furnished by the gold in the gravel. For example, the head of a creek or a tributary gulch that has a bed-rock which would retain gold, but does not contain pay gravel, would be an unpromising field for prospecting. On the other hand, the valley walls or the gulches at the head of pay gravel would be likely ground. For instance, Victoria gulch with No. 7 pup is almost at the head of the productive part of Bonanza creek. The gold is coarse, and in the upper part very rough and angular. Here, evidently, one is 'hot on the scent.' On No. 7 pup the gravel is angular, and consists of almost unworn slide rock. This should be a good place to prospect. Gay gulch, which heads with Victoria gulch, is also auriferous. This and the divide between the two gulches furnish favourable ground. A study of the geological maps and reports, and a consideration of the production from the various claims, will furnish numerous suggestions regarding other good points for attack.

When the gravels of a creek appear to be enriched on a certain claim as if from a local source of gold, it should first be determined if the excess supply has been derived from the White Channel paystreak. Only when this has not been the case may such enrichment be taken to indicate the presence of a rich vein in the immediate vicinity.

If coarse or unworn gold suddenly makes its appearance where normally only fine and worn gold might be expected, this would be indicative of a fresh, local supply from a nearby source. Such would be a favourable place to prospect.

Prospecting will be slow and tedious, hampered as it is by the lack of rock exposures and the mantle of loose rock. The latter is steadily creeping down hill, a point to be remembered when float is discovered. When a vein is found and sufficiently uncovered to show the character of the vein material unmixed with 'wash,' unless it is of pay grade it is usually unwise to sink on it or otherwise test it at depth in the hope that values will improve. If it is felt to be worth further development, it is usually better to prospect it horizontally rather than vertically. This can be done either by trenching, or if the cover is too deep, by drifting. Either will be cheaper and more rapid than sinking, and will test the vein as successfully, for the chance of striking better grade material along the vein is quite as strong as, if not stronger than down it, and much more of the vein is tested in the same time and for the same money. If, however, pay ore is encountered, it is advisable to sink on the ore as well as to follow the vein horizontally, for gold often exhibits a tendency to concentrate on the surface, and it is, therefore, necessary to demonstrate that the values continue downward. Until the ore shoot is well developed, so that certain knowledge is to be had of its position, dip, continuity, value, etc., in no case should expensive work be undertaken elsewhere than on the ore, under the assumption that it goes down, or has any particular attitude. 'Stick to the ore' is advice to be heeded. These points may seem too elementary to be worth making, but justification is furnished by the amount of money wasted in young camps, everywhere, by disregarding them, and by the frequent expenditure of time and money in a way that detracts from rather than adds to the value of the claim.

For the encouragement of prospectors it may be noted that, up to a certain point, the greater the number of veins that prove barren or almost so, the greater are the chances that some occur that are rich, for the reason that the fewer sources there are for the gold, the richer these sources must be.

Some light on the value of the quartz of veins might possibly be had from the quartz boulders of the gravels. Many will no doubt be from barren veins; many are cavernous. These probably held auriferous sulphide minerals which have been leached and the accompanying gold dropped out, in which case the values found would be too low. But tests made with discrimination and judgment might furnish some instructive results.

PLACER PROSPECTS.

It is to many a matter of surprise that the discovery of the Klondike has not been followed by that of other important placers in the Yukon. The possibility of this is not yet exhausted. Prospectors from the Stewart are bringing out encouraging reports of creeks, tributary to this river. In some respects the conditions are very favourable for placer mining. From information which appears to be reliable, the placer prospects of the Stewart River district are to be taken seriously. Two dredges are being operated on the river.

Information obtained from the Klondike may be used with advantage in prospecting for new placers. Here, as noted above, the essential points were, gold-bearing country rock (auriferous by reason of gold-bearing veins), a very long period of concentration of the gold through weathering and erosion with, in places, a reconcentration of the already rich gravels. The same conditions were essential in the formation of the placer camps of the lower Yukon—notably at Fairbanks and the Seward peninsula. (At Nome reconcentration was effected on several beach lines.)

The presence or absence of the essential factors in a district, except the auriferous character of the country rock, can be speedily recognized by an inspection of its topographical features and the condition of the surface and of the old gravels. Whether the country rock is gold-bearing, and so could have supplied gold to the gravels, is not so readily determined, but in certain cases, at least, this can be more readily ascertained (or at all events its probability indicated) by an examination of the materials of the gravels, the slide rock, and outcrops than by the more laborious digging and washing of the gravels.

For instance, in the Klondike, the amount of quartz, and particularly the suggestive character of the quartz in the numerous milky, cavernous boulders, would indicate a strong probability of the occurrence of gold, which, coupled with the pronounced evidences of mature weathering and erosion, and reconcentration, would have attracted the observant prospector and encouraged him to expend the necessary time and labour to thoroughly test the gravels.

If these underlying principles regarding the formation of placers are borne in mind, it will assist one in eliminating unpromising districts and in confining his attention to creeks where there are inherent possibilities for success.

Other Districts.

Placer mining is still in progress on tributaries of Sixtymile and on Fortymile rivers. Dredging is in progress on the latter.

The Sourdough coal mine below Fortymile river is in operation.

White River District.

The encouraging developments of the copper properties on Copper river, Alaska, to which a railway from the port of Cordova is being built, and the similar prospects on the north side of the Wrangell mountains in the Nabesna-White River district, has re-awakened interest in the possibilities of the upper portion of the White river on the Yukon side of the International Boundary line.

In 1905, McConnell made a reconnaissance survey of this district, his report being published in the Summary Report of the Geological Survey for 1905 (pages 19-26). In 1907, very fine specimens of rich bornite and chalcocite were brought out from this district.

In 1908, Messrs. Moffit and Knopf of the United States Geological Survey, examined the Nabesna-White River district, Alaska. Portions of their report[1] of special interest to Canadians, because referring to the Yukon, are here reproduced:—

[1] Mineral Resources of Alaska, 1908, United States Geological Survey Bulletin 379, pp. 161-180.

'COPPER.

General Conditions of Occurrence.

'The reported presence of native copper in vast quantities was, as already pointed out, the original incentive that drew the pioneer to the White-Nabesna region. Prospecting in search of these deposits has shown that copper in its bed-rock sources is widely distributed in the form of sulphides (chalcocite, bornite, and chalcopyrite), and on the basis of the facts revealed by the little development work that has been done, it may be stated that most of the native copper found in the region is an oxidation product of those sulphides. In mode of occurrence the copper ore shows two different habits, geologically distinct. In one, so far the better known, it occurs associated with the Carboniferous basaltic amygdaloids, and in the other it is found in limestone at or near the contact with the dioritic intrusives.

'Native copper occurs as nuggets in the gravels of many of the streams, and green-coated lumps of metal up to 5 pounds or more in weight are occasionally found in the wash of creeks draining areas of amygdaloid bed-rock. This stream copper was the source from which the Indians obtained their supply when it was an object of barter among them. From the accounts of Hayes and Brooks, Kletsan creek appears to have been the placer locality best known to the natives.

'Metallic copper occurs also in the surface croppings of sulphide deposits in the amygdaloids, where it is undoubtedly an oxidation product of the sulphides that appear in depth. In such places it is directly associated with the dark-red oxide (cuprite) and more or less green carbonate. At the prospect known as 'Discovery,' which is located in Canadian territory on White river, a few miles below the International Boundary, a large slab of native copper averaging 8 by 4 feet by 4 inches thick, and weighing probably close to 6,000 pounds, has been uncovered in the slide rock. A number of other sheets of copper up to several hundred pounds in weight have been found in the near vicinity. On account of the stimulus that this find has exerted on the prospecting of the adjacent American territory, the occurrence merits some description in this report. The stripping of the bed-rock near the great nugget exposes a face of green basaltic amygdaloid 20 feet high and 15 feet wide. The rock is traversed by numerous seams of native copper along fractures and slickensides, but toward the bottom of the open-cut stringers of chalcocite begin to appear. About 150 feet from this prospect an opening on an independent occurrence shows stringers of cuprite with admixed copper, stringers of glance and calcite, and chalcopyrite disseminated through the amygdaloid country rock. From these features it is clear that the metallic copper of this deposit is a superficial oxidation product of sulphides, that its downward extension is small, and that the prevailing sulphide at greater depth will probably turn out to be chalcopyrite.

'At a few localities native copper is associated with certain highly amygdaloidal portions of the Carboniferous basalts and intergrown with the white minerals that fill the former steam cavities in the ancient lava flows. Slaggy looking portions produced by the weathering and removal of the amygdules from the lava and amygdaloid that is cut by small irregular veinlets filled with the same minerals as those forming the amygdules appear to be the most favourable places for metallic copper. The copper in

the vesicles and stringers is associated with calcite and delicately spherulitic prehnite, but in some of the veinlets calcite, prehnite, quartz, a black lacquer-like mineral, partly combustible, and chalcocite, instead of metallic copper, are associated together.

'At a number of places throughout the region narrow stringers of chalcocite cutting the ancient basalts are encountered, but so far as known none have any great persistence. Near the head of Cross creek, locally known as Copper creek, a thin quartz-chalcopyrite vein cutting the bedded volcanic rocks has been discovered. At other localities some irregularly disseminated sulphides, in some places chalcocite, in others bornite, occur in the basalts, but these do not appear to be connected with definite vein or lode systems, and are consequently of an unencouraging character. Oxidation of these sulphides and disintegration of the containing rock give rise to the nuggets of cuprite and native copper that are found in the talus slopes at several places in the region.

'In contrast to these occurrences, which, as shown by the foregoing discussion, are limited to the ancient basalt flows, copper is found as bornite and as chalcopyrite intergrown with contact-metamorphic rock in limestone adjoining diorite intrusives. In deposits of this type the ore mineral is associated with garnet, coarsely crystalline calcite, epidote, specular hematite, and scattered flakes of molybdenite. The garnet is commonly crystallized in dodecahedra, and is intimately intergrown with the bornite and chalcopyrite. On account of its weight and especially its appearance, which is not unlike that of cassiterite, it was mistaken for tin ore by some of the early prospectors. Only two deposits of this character were seen in place, but evidences of energetic contact metamorphism were detected at a number of other localities. An extensive contact zone has been produced along the junction of the diorite and the massive limestone exposed on the ridge west of Copper pass. Various contact-metamorphic rocks, pyritiferous as a rule, are present in this zone, and these rocks on oxidizing give rise to large iron-stained outcrops, which contrast strongly with the surrounding white limestone. In connexion with the discussion of the contact-metamorphic deposits, it may be stated that the writers were shown some specimens of copper ore containing abundant large octahedra of magnetite and blebs of chalcopyrite in a gangue of coarse calc spar. This ore was undoubtedly obtained from the vicinity of an intrusive diorite-limestone contact, but whether commercially valuable ore bodies of this character exist in this region, which is so remote from transportation facilities, is yet to be demonstrated, in view of the fact that copper deposits of contact-metamorphic origin are characteristically bunchy and low grade.'

'Conclusions.

'The White-Nabesna region can be more easily prospected in some respects than many other parts of Alaska, on account of the relative abundance of bed-rock exposures. Most of the showings of ore found thus far are situated well up on the mountain sides, generally beneath walls of rock cliffs and above the encumbering talus slopes. This is, of course, to be expected in a region that is incompletely prospected, but it entails the disadvantage that the prospects are located far from timber. The greater number of the copper prospects are found in the Carboniferous basaltic amygdaloids, a relation which is also essentially true for those of the Chitina country.

The geologic investigation of the region has established the fact that these volcanic rocks have a considerable distribution, and underlie the greater part of the Wrangell mountains. Much of this territory, however, is unfortunately not accessible on account of its numerous glaciers and extensive ice fields.

'The main interest of the White-Nabesna region has centred in the occurrences of native copper. No phenomenal ore bodies have yet been discovered, but it has been shown that primary native copper occurs in the amygdules of zeolitic amygdaloids, a mode of occurrence unknown on the Chitina side of the Wrangell mountains. This discovery is sufficiently encouraging to warrant further development, and it is hoped that the nature and extent of the deposit will soon be demonstrated.

'From the descriptions given in the preceding pages, it will be apparent that a lode-quartz region of some promise has been discovered in the Nutzotin mountains, near the International Boundary, and that, as yet, it has been but imperfectly explored by the prospector. It was shown that the intrusion of quartz diorite produced a number of contact-metamorphic bodies of copper sulphides, and the occurrence on Jacksina creek suggests that the magma was also capable of effecting an auriferous mineralization. From the meagre data at hand it is perhaps unsafe to venture on generalizations, yet it is probable that the quartz veins are genetically related to the intrusion of the post-Carboniferous quartz diorites and that, therefore, the intruded areas are those most likely to be mineral bearing. Such areas are known to occur throughout the Nutzotin mountains at a number of localities, especially along the northeastern flanks. Brooks has mapped a large area of granular intrusive on the lower Nabesna. It is probable that in the vicinity of such masses the search for lode quartz may be prosecuted with the most hope of success.'

WEST AND EAST KOOTENAY.

From Victoria I went to Nelson, and attended a meeting of the Western Branch of the Canadian Mining Institute. Messrs. LeRoy and Boyd, who were engaged in Geological Survey work in the Slocan, were in Nelson to report progress.

Earl Grey at Ainsworth Cave.

His Excellency Earl Grey and party, who had ridden over the pass from their camp on Toby creek, were met at Argenta, at the head of Kootenay lake. His Excellency proceeded to Ainsworth, to visit the cave above the town, which had been only partially explored last season.[1] The party to explore the cave included Earl Grey, Lady Sybil Grey, Lady Evelyn Grey, and the Hon. Miss Broderick. After going to the head of the cave, a feat demanding some daring as well as skill, the lower unexplored portion was assailed. This proved disappointing, since, instead of opening up into a larger cavern as anticipated, in 100 feet the chamber closed up, the water escaping down a fissure too narrow to be followed. Evidently until a comparatively recent date the large chamber at the entrance formed the lower limit of the cave, and the water has for a short time only been at work on the fissure through which it now drains.

[1] Summary Report Geological Survey, 1908, pp. 21-22.

Kootenay-Columbia Divide.

Through the kindness of His Excellency, who proffered his saddle horses and camps, the writer, accompanied by Mr. Boyd, was able to cross over to the Windermere district by way of Hamill and Toby creeks.

From Argenta to Hamill creek, a distance of three miles, an old railway grade (constructed by the Great Northern railway from Argenta to Howser lake) is used as a wagon road. Crossing Hamill creek the road enters a cañon. For about a mile and a half the creek rushes through a deep box-cañon, one of the most beautiful and impressive of its kind in British Columbia. Bands of white and bluish marble form a considerable part of the almost vertical rock walls. The road is carried up on a rock cut shelf supplemented by trestles, but owing to small slides it is not now passable for wagons. Three miles up, at the head of the wagon road, is the Argenta compressor. The mine is situated on the hillside a couple of thousand feet above, but is now idle. A short distance above the compressor the trail skirts a burnt hillside, but soon enters a verdant forest, and from here to the head of the creek the natural beauty of the forest is unimpaired. The first camp was on Hamill creek in a meadow at the base of the climb to the pass. Up to this point the grade had been easy. A somewhat steep climb of a couple of thousand feet brings one to the level of the pass, which is low and easy considering the rugged nature of the mountains through which it leads. Several alpine glaciers lie close to the trail. Some of the peaks exceed 10,000 feet in elevation, and from their summits is to be seen one of the finest and most extensive panoramas in the Canadian Cordillera. Unfortunately when we were on the pass it was enveloped in fog, but in our Lardeau work we had occupied, as stations, peaks a few miles to the east, from which we gained a view of the country.

The trail from the summit down Toby creek has an easy grade. For the first half mile it is above a glacier. About eight miles down, on an open hillside, commanding a fine view of the valley, is the headquarters camp of His Excellency.

The character of the country on the Columbia slope is distinct from that on the Kootenay side of the divide. The vegetation is less dense, showing evidences of a drier climate, and altogether there is a sort of transition between the pronounced Selkirk type, and the Rocky Mountain type of country.

About 12 miles below the camp the trail joins the B.C. wagon road at a point about 18 miles from Wilmer, on the Columbia.

Suggested Parks.

These two valleys of Hamill and Toby creeks, with the adjacent mountains, particularly the portion from Argenta to Earl Grey's headquarters camp, form one of the most attractive of the easily accessible mountain districts in British Columbia, and the suggestion that they be reserved as a provincial park is well worth carrying out.

With rail communication to supplement the present boat service, as there soon will be along the Columbia-Kootenay valley from the Canadian Pacific Railway main line at Golden to the Crows Nest Pass line, and with the boat service on Kootenay lake, such a park would act as a strong magnet to tourists.

Another magnificent site for a park exists up the Duncan river, in the 'Lime dike' country, about the head of Hall, Haley, Caribou, Gainer, and Porcupine creeks. Here the scenery is of the peculiarly wild, airy type of the famous 'Dolomites' of the Tyrolean Alps. It is also of easy access for an energetic tourist.

Such parks would mean a great deal in the future tourist travel in southern Kootenay, which can soon be made one of the big 'industries' of the Province, so that in addition to preserving in its natural state the grandest of mountain scenery, and forming a game and timber reserve, they would become most valuable provincial assets.

Geology.

The trip was made too hurriedly for geological work, which, on account of the folding and other disturbances, would have to be done in detail.

The rocks up Hamill creek consist of schists, often garnetiferous, slate, limestones, and quartzites. Near the summit is a fine-grained conglomerate.

On Toby creek, slates and limestones extend to Earl Grey's camp. From here to the wagon road are quartzites and dolomite. The rock at the wagon road is a heavy green schist. Up the little cañon of a tributary stream which the wagon road to the B.C. mine follows, is a succession of 'soda springs,' giving off carbonated waters containing lime and iron, and which have deposited a red tufa.

For several miles below Pinehurst, where the road to Paradise mine takes off, is a conglomerate, in some places coarse and in others fine, with boulders and pebbles of limestone, slate, and jasper. The dip here is about 45° west.

About 8 miles from Wilmer the rocks appear to be mainly flat lying. Along the lower end of the road, limestone and schists occur, rather massive and crystalline, having an older appearance than the rocks previously encountered. Some jasper-like bands which may have yielded the pebbles seen in the conglomerate were also noticed.

Very little activity in mining or prospecting was reported in the Windermere district. With the building of the railway there will probably be a renewal of interest in this section, for many promising leads with ore of good value have been found and partially developed, and from some considerable shipments have been made, in spite of the present difficulties of transportation.

The Paradise, on Spring creek, a tributary of Toby, is the best developed mine. It has over a mile of workings, and has shipped more than 2,000 tons of ore taken out in development, which is said to have yielded average smelter returns of 57·44 ounces of silver and 58·9 per cent of lead to the ton.

W. Fleet Robertson, who visited the property in 1903,[1] states that, 'in the mine workings much ore is in sight and more is demonstrated almost to a certainty. A rough calculation made at the time (July, 1903) gave, if not of ore actually 'blocked out' certainly of 'probable ore,' about 50,000 tons, which amount there is every reason to expect has been largely increased by subsequent developments.'

Most of the veins in the district are silver-lead, though some have gold-copper or zinc values. The silver is usually carried in tetrahedrite, and the gold in pyrite. Some

[1] Report of the Minister of Mines, B.C., 1903, p. 101.

veins from which shipments have been made have produced rich ore, carrying several hundred ounces to the ton.

Trail Creek Mining Division.

From Wilmer, we took the steamer down the Columbia to Golden, and returned to Nelson. Half a day was spent at the smelter and refinery of the Consolidated Mining and Smelting Company at Trail, and a day at Nelson.

The smelter at Trail is probably the largest and most complete of its kind in America. It is designed to treat all the varied ores produced in the Kootenays with the exception of zinc. The mines owned by the Company assure a steady, heavy tonnage of the various classes of ore required, but all the custom ore offered is also purchased, thus affording the smaller mines the advantage of large scale smelting operations. During the year a new lead furnace, with a capacity of 250 tons, replaced one of the two, old 140 ton furnaces. Mechanical feeds were provided for both the lead furnaces. A new copper furnace of 450 tons daily capacity replaced a smaller furnace, and a No. II Root blower was added to the plant. An additional Huntington Haberlein roaster was installed, and another is being erected. The capacity of the lead refinery has been doubled during the year.

The daily capacity of the plant is now 2,100 tons of gold-copper ore, and 500 tons of silver-lead ore, and that of the refinery is 120 tons of pure lead. The chief products of the plant are refined gold, silver, and lead; sulphate of copper; electrolytic bearing-metal; and gold-copper matte. The output for the year will probably exceed $5,850,000 in value, notwithstanding the low price of metals. The copper matte is sold to the Tacoma refinery; the gold to the United States Assay Office; the silver to the Canadian market including the Canadian Mint, also to China; the lead supplies the Canadian market, the surplus being disposed of in China and Japan.

The development of the Centre Star mines at Rossland has been vigorously prosecuted, over 3 miles being added during the year to the 20 miles of workings. A number of extensive new ore bodies were opened up through this development work, especially on the War Eagle. The Le Roi No. 2 has maintained its record as a steady producer and dividend payer.

The output of the Rossland camp for the year, however, will be lower than usual, owing to the fact that the Le Roi, until recently much the heaviest shipper, has produced very little ore this year. A vigorous policy of exploration has been carried on in the Le Roi during the latter half of the year, which it is hoped will result in important developments.

The Evening Star and Blue Bird were operated for a time, and the Velvet was about to be reopened at the time of my visit.

Turtle Mountain.

On the return journey to Ottawa, a stop of a day was made at Frank, Alta., to examine Turtle mountain, especially the north shoulder above the town. The summit now presents a more dilapidated appearance than immediately after the great landslide. The breaking away of material back to the limits of the cracks formed at the time of the slide, leaves a more widely gaping hole, with the north shoulder outstand-

ing. A large amount of material has still to come from the south peak, which is traversed by two major crevasses some distance back from the face of the cliff. This peak is so situated that falls from it are not likely to cause damage. On the north peak, overlooking the town, a break is not impossible, especially if artificial excavations are made near its base. A rather fresh looking crack extends across the ridge and down the west slope between the summit of the north peak and the shoulder overlooking the town. Two cracks parallel to the face of the ridge occur on this shoulder between the main ridge and the edge of the cliff.

While, on this shoulder there is little or no evidence of movement, and it still presents an appearance of solidity, it must not be forgotten that it is projecting outwards without support except at the west end, and that its cliff face is high and steep. The same causes which brought about the former catastrophe might produce a similar effect upon this shoulder of the mountain. If a large mass were detached from it, it would certainly reach the valley bottom, and there is nothing, as there was in the former slide, to prevent its spreading fan-like down the slope and over the valley bottom.

BORING ON PRINCE EDWARD ISLAND.

The surface of Prince Edward Island is composed of rocks belonging to the group now spoken of as Permo-Carboniferous. Ever since the first geological examination made on the island, the possibility has been recognized of the underlying Carboniferous containing an extension of the coal basins of Cape Breton and Nova Scotia.

Unfortunately, surface study cannot throw any light on this question. The strata are nearly flat, and only a limited section of the rocks is exposed.

Information can be obtained only by boring. The Provincial government recently appealed to the Dominion to undertake this investigation, pointing out that, although under the terms of confederation geological investigations should be carried on in Prince Edward Island, little had been or could be done, and suggesting that, in lieu of surface studies, geological sections by means of bore-holes be obtained.

If coal were found within commercial distance of the surface it would mean much to the island. There was also a possibility that gas or oil might be encountered. Moreover, any information gained would be valuable to the neighbouring provinces. The proposal of the Prince Edward Island government was, therefore, accepted, and a sum allotted for the work.

For a complete and satisfactory test, four or five deep holes at selected points on the island would have to be drilled. To get this done for the money available, in rocks which, from a drilling standpoint, were unknown, the cheapest and best all round mode of drilling would have to be employed. A contract was accordingly let to an experienced driller for 10,000 feet of boring with a standard drilling rig (churn drill).

Several low anticlines cross the island, and as the strata exposed on these belong to a lower horizon than is to be met with elsewhere on the island, and as anticlines form the most likely points for gas or oil reservoirs, the sites for bore-holes were selected on these. From the work of Sir William Dawson and Dr. Ells, the anticline at Gallas point appeared to be the best spot for the initial hole, as the rocks there were supposed to be the lowest strata exposed on the island.

No. 1 hole was located on the farm of Jas. Tweedie. This is a little south of the axis of the anticline; but because of the low dip it was unnecessary to locate precisely on the axis to secure depth; moreover, the chances for gas or oil are better a little off the axis. It was started as a 10 inch hole.

Hole No. 2 was located about two miles north, on the other side of the axis, where the surface rocks appeared more solid, in the hope that water-bearing strata, encountered in No. 1 hole, might be less pervious on the north limb of the anticline. In order to increase the chances of attaining depth, the diameter of this hole was increased to 13 inches.

Hole No. 3 was bored near Kinross on the same anticline, but about 7 miles inland. This and the remaining holes were started as 18 inch holes.

Hole No. 4 was drilled near Little Sands, on the next recognized axis. This was the nearest spot on the island to the known coal fields of Nova Scotia (Pictou basin). This anticline and the preceding one, in their southwesterly extensions, pass on either side of the Springhill coal basin, in Nova Scotia.

Hole No. 5 was located near Miminegash, on the west side of the island, as close as possible to the axis of the most westerly anticline.

The drilling was done by contract, the Survey having a representative at the well to examine the drillings, keep the log of the well, and to forward samples, taken every 10 feet, to the department, where they were again examined and filed.

Well Boring Logs.

Mr. E. D. Ingall, of the Boring Division, furnishes the following logs of the wells from an examination of the samples in the office and from the records kept by Mr. Ferguson, who looked after the interests of the Survey on the ground.

It will be noticed that more than ordinary efforts were made to push the borings to great depths. Ordinarily an 8 inch hole is deemed sufficiently large, whereas No. 1 was started as a 10 inch, No. 2 as a 13, and the remainder as 18 inch holes. The softness of certain strata and the number of heavy water-bearing beds encountered made it impossible to get much below 2,000 feet.

PRINCE EDWARD ISLAND.

'*Bore-hole No. 1* (Boring Files No. 203). Prince Edward Island, Gallas point, near Charlottetown, Queens county.

'The rocks encountered were as follows, as shown by the samples of drillings:—

Surface to 165 feet	Brownish, earthy shales.
165– 215 feet	Brown, sandy, calcareous shales.
215– 295 "	Brown, earthy shales mottled with greenish grey.
295– 395 "	Blue-grey, sandy shale.
395– 435 "	Grey, calcareous sandstones.
435– 995 "	Brown shales.
995–1,015 "	Purple-grey sandstone.
1,015–1,125 "	Brown shales.
1,125–1,155 "	Grey shales.
1,155–1,165 "	Brown sandstone.
1,165–1,190 "	Brown shales.
1,190–1,205 "	Grey shales.
1,205–1,395 "	Brown shales.
1,395–1,405 "	Brown sandstone.

1,405–1,620	"	Brown shales.
1,620–1,650	"	Brown sandstone.
1,650–1,660	"	Red-brown, sandy shale.
1,660–1,880	"	Brown shales getting redder towards bottom.
1,880–1,900	"	Coarse grey sandstone.
1,900–1,910	"	Brownish-grey shaly sandstone.

'Soft water was encountered at 35 to 45 feet and 150 feet, and salt water at 635 feet and 1,875.

'The hole was started with a 10 inch drive pipe and an 8 inch casing, which had to be reduced, owing to water and caving. At 1,800 feet a cave took place, necessitating the introduction of a string of 5⅝ inch casing. At 1,910 feet the soft, porous sandstone was caved through the pressure of the salt water.

'The samples from the series of beds passed through in this hole, effervesce freely with acid, showing the presence of carbonate of lime and, possibly, of magnesia, the only exceptions being the samples from some of the sandy beds.

'*Well No. 2* (Boring Files No. 205). Two and a half miles northeast of Earnscliffe, Queens county.

'The log of this well was as follows:—

Surface to 750 feet		Reddish-brown, calcareous shales.
750– 790 feet		Reddish-grey, calcareous sandstone.
790–1,090	"	Reddish-brown, calcareous shales, somewhat mottled with greenish grey.
1,090–1,140	"	Purplish-brown sandstone.
1,140–1,230	"	Purplish-brown sandy shale.
1,230–1,420	"	Brown shale.
1,420–1,480	"	Purple-brown sandstone.
1,480–1,495	"	Purple-brown shale.
1,495–1,530	"	Purple-brown sandstone.
1,530–1,550	"	Red-brown shale.
1,550–1,570	"	Purple-brown sandstone.
1,570–1,665	"	Purple-brown sandy shales.
1,665–1,680	"	Purple-brown sandstone.
1,680–1,685	"	Purple-brown shale.

'At this depth it was found impossible to drill further, and the hole was abandoned. Water was encountered in the hole at 8 feet below the surface, and again at 55 feet, and at 750-1,100 and 1,450 feet salt water came in. The latter three depths, it will be noted, coincide with beds of sandstone penetrated.

'The hole was cased with 10 inch pipe to 600 feet; with 8½ inch pipe to 926 feet; with 6¾ inch pipe to 1,374 feet, finishing up with 5 inch pipe to 1,464 feet.

'*Log of well No. 3* (Boring Files No. 206). Prince Edward Island, Queens county, one-half mile northeasterly from Kinross, and one mile east of Glencoe station:—

Surface to 10 feet		Argillaceous sand, red.
10– 40 feet		Red, sandy shale.
40– 50	"	Red, gravelly shale.
50– 80	"	Red, sandy shale.
80– 90	"	Red sandstone.
90– 140	"	Red, sandy shale.
140– 150	"	Red sandstone.
150– 160	"	Red, sandy shale.
160– 170	"	Red shale (Conglomerate), pebbles of limestone, sandstone, and shale, some stained greenish.
170– 190	"	Red shale, mottled with green.
190– 230	"	Red, sandy shale, mottled with green.
230– 255	"	Reddish sandstone, rather coarse to finer grained.

255–	260	feet.. .. .. Red, soft shale (water still fresh).
260–	330	" .. .. Red, sandy shale, hard with occasional hard beds of purer sandstone, as shown by working of the drill.
330–	350	" .. .. Red shale, soft.
350–	380	" .. .. Red sandstone, coarse to fine and shaly.
380–	400	" .. .. Red, soft shale.
400–	410	" .. .. Grey sandstone.
410–	430	" .. .. Medium hard, red shale, with sandy, gravelly layers.
430–	440	" .. .. Micaceous and calcareous shale.
440–	470	" .. .. Fine to coarse grained, red sandstone, moderate supply fresh water.
470–	530	" .. .. Medium hard, red sandstone with some shaly layers.
530–	560	" .. .. Red, sandy shale.
560–	590	" .. .. Soft, red sandstone.
590–	710	" .. .. Sandy shale, red, with some purer shale layers.
710–	830	" .. .. Soft, red shales, with occasional layers of marl often mottled with green.
830–	900	" .. .. Shaly sandstone, red, with occasional shale and sandstone layers.
900–	910	" .. .. Calcareous, red sandstone.
910–	930	" .. .. Gravelly shale.
930–	1,030	" .. .. Soft, red sandstone.
1,030–	1,080	" .. .. Calcareous, soft red shale.
1,080–	1,340	" .. .. Sandy shale, shaly sandstones, red and soft, fine grained, and calcareous; occasional sandstone beds.
1,340–	1,420	" .. .. Soft, red shale, calcareous and becoming sandy at bottom.
1,420–	1,500	" .. .. Soft, red sandstone with some shale.
1,500–	1,520	" .. .. Sandy shale, red.
1,520–	1,680	" .. .. Soft, red shale with sandy layers.
1,680–	1,750	" .. .. Soft, red sandy shales.
1,750–	1,765	" .. .. Sandstone, soft, red.
1,765–	1,790	" .. .. Soft, red shale.
1,790–	1,810	" .. .. Sandstone, soft, red.
1,810–	1,860	" .. .. Sandy and gravelly shale.
1,860–	1,910	" .. .. Sandstone, somewhat shaly at bottom.
1,910–	1,920	" .. .. Soft, red shale.
1,920–	1,940	" .. .. Sandstone, soft, red calcareous.
1,940–	2,025	" .. .. Soft, red shale.
2,025–	2,044	" .. .. Soft, red sandstone.

'This well was terminated at a depth of 2,044 feet on account of the heavy water supply encountered, and of the constant caving in of the sides of the hole due to the soft nature of the rocks.

'It was cased with 13 inch pipe to a depth of 424 feet; with 10 inch pipe to a depth of 907 feet; with 8¼ inch casing to the depth of 1,418 feet 8 inches; with 6⅝ inch casing to a depth of 1,787 feet; with 5⅜ inch casing to the depth of 1,993 feet, from which depth the hole was finished with a 5 inch drill.

'Seams of water were encountered in the hole at various depths as follows:—

At	30	feet.. .. .. A heavy flow of hard water rising to within 4 feet of the top.
	210	" .. .. Water still fresh.
	260	" .. .. "
	390	" .. .. "
	410	" .. .. The above was cased off.
	460	" .. .. Water in moderate amount.
	520	" .. .. Water rising in hole.
	550	" .. .. Water steadily rising, still fresh.
	630	" .. .. Water still rising and fresh.
	670	" .. .. Water risen to within 75 feet of the surface.
	690	" .. .. Water still fresh but stationary as to level in hole.
	770	" .. .. Water still fresh.
	890	" .. .. Water brackish.
	930	" .. .. Water during cessation of operations over Sunday rose to within 150 feet of top, but was bailed out on Monday.

990 feet	Water harder to keep under.
1,010 "	Water supply too heavy for bailing; drilling continued under water.
1,090 "	Water up to about 150 feet from surface.
1,430 "	Salt water encountered.
1,640 "	Water still stationary at 150 feet from surface.
1,770 "	Water above this all shut off by casing.
1,810 "	A little salty water.
1,880 "	Heavy flow of water.
1,910 "	Water too heavy to keep bailed out.
1,950 "	During Sunday water rose to level of 150 feet from surface.
1,980 "	All water above this shut off by casing.
2,030 "	Heavy flow of salt water rising to within 150 feet of surface and prohibiting further drilling.

'*Log of well No. 4* (Boring Files No. 207), 1¼ miles from 'Little Sands,' Kings county.

'The log of the bore is as follows:—

Surface to 25 feet	Sandy clay.
25– 420 feet	Firm, red, shaly sandstone. 'The drillings show small fragments of pebbles of conglomerate, several hundred feet of which are exposed in the vicinity, dipping in such a direction that it must be drilled through in the hole.'
420– 430 "	Bright red, firm shale.
430– 442 "	Firm, red, shaly sandstone.
442– 450 "	Firm, red sandstone.
450– 520 "	Shaly sandstone, red.
520– 540 "	Conglomerate of coarse-grained sandstone.
540– 580 "	Firm, bright-red shale.
580– 680 "	Red, shaly sandstone.
680– 710 "	Firm, red shale.
710– 740 "	Coarse, red sandstone (conglomerate).
740– 790 "	Shaly sandstone, red, and firm.
790– 800 "	Red shale.
800– 880 "	Red, sandy shale.
880– 890 "	Coarse, shaly sandstone or conglomerate.
890– 990 "	Shaly, red sandstone.
990–1,020 "	Firm, red shale.
1,020–1,100 "	Firm, red sandy shale.
1,100–1,130 "	Firm, red shale.
1,130–1,150 "	Shaly sandstone, red.
1,150–1,170 "	Firm, red shale.
1,170–1,190 "	Shaly sandstone.
1,190–1,360 "	Firm, red shale.
1,360–1,420 "	Firm, red, sandy shale.
1,420–1,450 "	Sandstone, somewhat shaly.
1,450–1,560 "	Shale, red.
1,560–1,595 "	Sandstone.
1,595–1,620 "	Shaly sandstone.
1,620–1,640 "	Shale.
1,640–1,660 "	Shaly sandstone.
1,660–1,690 "	Sandy shale.
1,690–1,720 "	Sandy shale.
1,720–1,730 "	Shale.
1,730–1,740 "	Sandy shale.
1,740–1,760 "	Sandstone.
1,760–1,770 "	Sandy shale.
1,770–1,790 "	Shale.
1,790–1,810 "	Shaly sandstone.
1,810–1,820 "	Sandstone.
1,820–1,830 "	Shaly sandstone.
1,830–1,840 "	Shale.
1,840–1,880 "	Shaly sandstone.
1,880–1,885 "	Shale, sandstone.
1,885–1,970 "	Shale, red and firm.
1,970–1,980 "	Red, sandy shale.
1,980–2,000 "	Red, shaly sandstone.
2,000–2,010 "	Red, sandy shale.
2,010–2,040 "	Firm, red shale.
2,040–2,050 "	Shaly, red sandstone.
2,050–2,082 "	Firm, red sandstone.

Water was encountered in this well as follows:—

At 35 feet	Large flow of fresh, hard water.
150 "	Salt water here first noticed to affect the freshness of the water in the hole.
200 "	Water quite saline; and level in well is affected by rise and fall of the tide.
442 '	Above water cased off.
450 "	Salt water encountered, but not enough to flood the well.
540 "	Great flow of salt water in conglomerate or coarse sandstone—too much to handle with bailer; rises and falls with tide.
890 "	Above cased off.
910 "	Fresh water struck in this layer.
950 "	Flow of water increasing and becoming too great to bail out; drilling continued under water.
1,010 "	Water becoming brackish.
1,140 "	Water decidedly saline.
1,190 "	Water up to tide level.
1,414 "	Above cased off.
1,430 "	Fresh water in small quantity.
1,560 "	Considerable flow of fresh water.
1,610 "	More water.
1,650 "	More water, too heavy to bail out.
1,713 "	Above cased off.
1,750 "	A little brackish water.
1,820 "	Quite a large flow of brackish water.
1,860 "	Large flow of brackish water too great to be
1,895 "	bailed out. Above cased off.
1,990 "	Moderate flow salt water.
2,060 "	Heavy and increasing flow of salt water.

'This hole was cased with 10 inch pipe to 890 feet; with 8¼ inch casing to 1,414 feet; with 6⅝ inch casing to 1,713 feet; with 5¼ inch casing to 1,895 feet.

'At the lowest depth, 2,082 feet, the pressure of the large flow of water was so great that drilling could not be continued.

'*Well No. 5* (Boring Files No. 208). Miminegash, near Ebbsfleet, Prince county,

'The log of this well is as follows:—

Surface to 220 feet	Bright terra-cotta coloured, earthy looking shales.
220– 370 "	Paler terra-cotta coloured, sandy shales.
370– 410 "	Paler terra-cotta coloured shales.
410– 440 "	Pale terra-cotta coloured, sandy shales.
440– 470 "	Purplish, sandy shale.
470– 515 "	Pale terra-cotta coloured, sandy shales.
515– 540 "	Terra-cotta coloured shale.
540– 730 "	Paler pink, sandy shale.
730– 800 "	Coarse, grey sandstone.
800– 810 "	Terra-cotta coloured, sandy shales.
810– 840 "	Terra-cotta coloured, shaly sandstone.
840– 950 "	Terra-cotta coloured, earthy shale.
950–1,060 "	Grey, calcareous sandstone.
1,060–1,140 "	Grey, soft shales, showing carbonized matter as a scum on top of the pumpings.
1,140–1,340 "	Brownish-grey to grey, soft sandy shales.
1,340–1,440 "	Grey, firm sandstones. Pumpings showing traces of 'carbonaceous matter.'
1,440–1,490 "	Brown shale.
1,490–1,560 "	Grey, firm sandstone. Pumpings show scum of carbonaceous matter.
1,560–1,660 "	Brown, soft shale, lighter coloured at bottom.
1,660–1,670 "	Grey, soft sandstone.

'At this depth the hole had to be abandoned, the shale caving in and burying the tools.

'Fresh water was encountered in the hole at 230 feet; a very heavy flow, which rose to within 30 feet of the surface. At 460 feet a very heavy flow of fresh water was

again encountered, the previous flow having been cased off. This water finally rose to tide level. At 620 feet the water began to get brackish. At 871 feet the water was cased off, and a heavy flow of salt water was encountered at 960 feet, which rose to sea-level when the boring attained a depth of 1,020 feet. The upper water was cased off at 1,279 feet, but another heavy flow of salt water was met with at 1,350 feet, which by the time 1,470 feet of depth had been attained had risen to sea-level. At 1,470 feet the upper water was again cased off, but a further supply of very salt water was met with at 1,480 feet, rising to within 100 feet of the surface. This was cased off at 1,562 feet.

'Great difficulty was met with throughout the operations due to the heavy flow of water and to the constant caving of the brown shales where encountered, and the difficulty of drilling in this class of rock when the hole was full of water.

'In comparing the characteristics of the rocks passed through in the above-described borings, the detailed lithological descriptions do not give the broadly distinctive contrasts which are evident when they are compared with each other as a whole. A full series of samples taken at intervals of 10 feet is on file in the department, from the study of which certain general differences are evident.

'In holes Nos. 1 and 2 the general colour of the samples is brown-red—sometimes mottled with greenish grey and toned down to purplish. For the whole depth of holes Nos. 3 and 4 and the upper part of No. 5 to a depth of about 950 feet, the samples exhibit a marked, bright terra-cotta red colour, toned down to purplish red in the sandy strata. In the lower portion of No. 5, grey to purple-grey, sandy beds predominate, with occasional recurrences of purplish-brown, shaly beds.'

Drill holes 2, 3, and 4 do not appear to have reached the bottom of the red beds of the Permo-Carboniferous.

No. 1, judging from the drillings, reached the lower grey beds of this formation at 1,890 feet, or 30 feet above the point at which the well had to be abandoned.

When I was searching for a site for No. 5 hole near Miminegash, it was noticed that the rocks contained strata not seen in the eastern part of the island, and that recrystallization about the sand grains was marked. This led to the hope that the surface rocks belonged to a lower horizon than those at the other bore-holes. Apparently this is the case, for the red beds extended to about 950 feet only, the remainder of the hole, to the bottom (1,660 feet), being in the lower, grey beds of the Permo-Carboniferous.

As there seemed to be a chance of getting into the Carboniferous with this hole, arrangements were made, through the kindness of Mr. Donkin, of the Mining Department of Nova Scotia, for a core drill to replace the churn drill when the water pressure would make it impossible to proceed farther with the latter. Unfortunately, before this point was reached, a heavy caving occurred, which buried the tools and the hole was lost.

Consequently, the Carboniferous has not been tested. But though the question of the extension of the coal basins from Cape Breton and Nova Scotia is still unsettled, it has now only an academic interest, so far as Prince Edward Island is concerned, since the work done has demonstrated that no coal occurs within commercial reach of the surface. The bore-holes average nearly 2,000 feet in depth, and have not reached the Carboniferous, which would have to be penetrated several hundred

feet before the Coal Measures would be encountered. The unstable nature of the rocks and their saturated condition would make sinking and maintaining a shaft a very difficult and expensive engineering feat.

No signs of oil or gas were obtained. The large column of salt water in the deeper levels makes it improbable that they should be found within a reasonable distance of the surface.

If, in the distant future, changed economic and engineering conditions should render the possibilities of oil, gas, and coal in the island a practical, commercial question, the pioneer work now done will furnish definite data upon which plans and estimates can be made, and the problem attacked in such a way that it can be conclusively settled.

While it is disappointing that no available mineral resources should have been discovered during this work on Prince Edward Island, it should be borne in mind that rarely in a limited area are rich agricultural and mineral resources associated, and of the two the island possesses in its agricultural land the more lasting and valuable asset.

OIL PROSPECTS OF ALBERTA.

As the attention of the public has been drawn to the oil and gas possibilities of Alberta, and opinions of various officials of the Geological Survey have been quoted and misquoted, it may be well to outline the known facts regarding the possibilities, and the inferences to be drawn therefrom.

The geology of the northwest provinces is summarized by Dowling as follows:—[1]

'At the eastern edge of Manitoba, and extending northwesterly, appears the old Archæan plain on which, to the southwestward, are laid successive beds of Palæozoic limestones, in their turn covered by heavy deposits of shales and sandstones, mainly of Cretaceoeus age; though remnants of Tertiary deposits are found on this Cretaceous plateau. The Palæozoic rocks, which disappear under this mass of shales along its eastern edge, appear again in the Rocky mountains by faulting, and their load of softer rocks is there almost all removed, leaving traces only of the lower members in some of the valleys.

'The formations exposed in this part of the continent, therefore, range in age from the rocks of the Archæan complex, through the Palæozoic and Mesozoic to the Cenozoic. As before remarked, lying on the Archæan floor in Manitoba are exposed limestones correlated with the Ordovician and Devonian of other parts of the continent. These consist mainly of dolomitic beds that are flat lying, and form inconspicuous topographic features. In the Rocky mountains, in addition to this series, limestones and calcareous shales of Carboniferous age occur.

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[1] The Coal Fields of Manitoba, Saskatchewan, Alberta, and Eastern British Columbia, by D. B. Dowling. Geol. Survey Publication No. 1035, pp. 19-27.

TABLE OF FORMATIONS.

	Groups.	Alberta.	Saskatchewan.	Manitoba.	Montana.	Dakota.	Kind of Rocks.	Character of Fossils.	Economic Value.
Tertiary.	Miocene. Eocene.	Miocene. Paskapoo.	Miocene.				Conglomerates and sandy clays.	Land and fresh water.	
			Laramie.	Laramie.	Laramie.	Laramie.			
		Edmonton.					Sandstones and clays.	Fresh water.	Building stone.
Cretaceous.	Montana.	Bearpaw.	Pierre-Foxhill.	Odanah.	Foxhill.	Foxhill.	Sandstones and clays.	Land plants. Brackish water.	Coal.
		Belly R.	Belly R.		Bearpaw.	Pierre.	Shales.	Marine.	
					Judith R.		Sandstones.	Brackish and fresh water.	Coal
		Claggett.		Millwood.	Claggett.	Pierre.	Shales.	Marine.	
		Eagle.			Eagle.		Sandstones.	Marine.	
	Colorado.	Niobrara. Cardium.	Niobrara.	Niobrara.	Niobrara.	Niobrara. Greenhorn.	Calcareous shales.	Marine.	
		Benton.	Benton.	Benton.	Benton.	Benton. Graneros.	Shales.	Marine.	
	Dakota.	Dakota.	Dakota.	Dakota.	Dakota.	Dakota.	Sandstones.	Fresh water.	Some coal.
	Kootanie.					Fuson. Minnewaste. Dakota.	Sandstones and shales.	Land plants.	Coal.
		Kootanie.			Cascade. Kootanie.	Morrison.			
Jurassic.		Fernie.			Ellis.	Unkpapa.	Shales and sandstones.	Marine.	
						Sundance.			
Triassic.		Banff shale.				Spearfish.	Red shale.	Marine.	
Carboniferous.		Banff lime.			Quadrant.	Minnelusa.	Limestone and quartzites.		
					Madison.	Pahaspa.		Marine.	Lime and cement.
Devonian.		Intermediate Series.	Winnipegosan.	Manitoban. Winnipegosan.	Monarch.		Limestone.	Marine.	Lime and cement.

'The Mesozoic section is complete only in the vicinity of the mountains.

'The lower beds—red sandy shales—have been found north of the Saskatchewan to contain Triassic fossils. This red series is in turn covered by dark shales of marine origin, with fossils of a Jurassic type. They are everywhere found beneath the lowest coal measures, which are assigned to the Cretaceous, and form narrow beds running parallel to the ranges. No exposures of these Jurassic rocks are known east of the foothills.

'The lower Cretaceous consists of sandstones, and brown and black shales, in which are numerous coal seams. These rocks do not appear east of the foothills. The thickness of the formation increases westward, and is at its maximum in the Elk River valley, where it has a thickness of about a mile.

'The middle part of the Cretaceous, consisting of shales of marine origin, forms the plateau extending from the mountains to within the borders of Manitoba. The general topography, with its deeply incised valleys, is derived mainly from the erosion of these soft rocks.

'The upper part of the Cretaceous section, although for the most part marine shales, grades upward to sandy measures of brackish water origin. The harder beds of this upper part form many of the stronger topographic features, both of the foothills and plains. Few exposures are to be found in the mountains, where they have been almost entirely removed by erosion.

'The Tertiary rocks are . . . . . sandstones with some shales and conglomerates. Exposures are to be found in the higher plateaus, such as Cypress hills and Wood mountain, and in the trough which extends north from the International Boundary in the foothills, including the Porcupine hills, and the sandstones at Calgary. The northern extension crosses the Saskatchewan west of Edmonton.

'The later deposits, such as the glacial till and the Saskatchewan gravel, will be but briefly mentioned. The glaciation of the mountains spreads a mantle of till through the foothills. The till of the Keewatin glacier does not always reach the eastern margin of the Rocky Mountain till, and they are possibly of two distinct periods. The eastern derived till is thin on the uplands, and often appears to have been rearranged by deposition in water. Morainic deposits occur on the Coteau in eastern Saskatchewan, and in Manitoba. Glacial lake phenomena have been observed at several parts; but the Lake Agassiz beaches of Manitoba, and the upper Red river, have formed the subject of several interesting reports.

'*Summary Description of Formations.*

'*Devonian—*

'In Manitoba, the Devonian rocks are divided into three series, Upper, Middle, and Lower.

'*Upper Devonian or Manitoban—*

'Light grey, hard, brittle limestone with red argillites at base; thickness about 200 feet.

'*Middle Devonian or Winnipegosan—*

'Light yellow, hard dolomite, with porous beds beneath; thickness about 200 feet.

'*Lower Devonian*—

'Mainly red shales; thickness about 100 feet. These beds probably represent only the upper part of the lower Devonian of eastern America.

'In western Saskatchewan these beds may be found near the Churchill river, having nearly the same characters.

'In Alberta, the most eastern exposure is in the neighbourhood of Athabaska river. In the Rocky mountains they form the Intermediate series, described by R. G. McConnell as being brownish, irregularly hardened dolomites, and greyish, crystalline dolomites, with some sandstones and quartzites.

'*Carboniferous*—

'As will be seen by the table, these rocks are found in South Dakota, Montana, and Alberta. They are not exposed in Manitoba nor along the northwest margin of the Cretaceous plateau, but are confined to the Rocky Mountain uplift. They have been subdivided on lithological characters into upper and lower Banff limestones. These formations are each capped by shaly beds, from which have been obtained a few characteristic fossils. The formation is generally a bluish limestone, and forms the summits of Cascade and Rundle mountains near Banff. A thickness of over 7,000 feet has been observed for the formation in the Bow valley.

'*Triassic*—

'A series of red, sandy shales, capped by a thin bed of yellow dolomitic limestone, exposed along the western slopes of many of the ranges, occurs at Banff, and has been called the upper Banff shale. Few fossils could be found at this locality in these measures; but in their continuation north to the Brazeau, several shells resembling *Monotis* help the correlation with the Triassic rocks of the Peace and Pine rivers. South of the Kootenay pass these rocks are associated with a volcanic trap outflow.

'*Jurassic*—

'*Fernie Shale*—

'In the locality where this formation received its name—near Fernie, B.C.—it consists of a series of black and brownish shales, 1,060 feet in thickness, overlying 500 feet of sandy argillites. Eastward, through the Crowsnest pass, the series decreases in thickness, and at Blairmore, near the edge of the mountains, there are only 700 feet. On the Cascade river the section is 1,600 feet, and consists of black shale and grey sandstones, with an occasional limestone bed toward the base. In the Moose Mountain area—an outlier of the Rockies—the thickness is only 225 feet. The formation has been traced northward to the Athabaska river, and preserves its general black, shaly appearance. Few fossils have been obtained in these measures, but these are characteristic . . . . .

'*Cretaceous*—

'*Kootanie*—

'The lower member of this series of deposits is found resting upon the Jurassic in the Rocky mountains. In Manitoba it has not been recognized, and is supposed to have formed but a very thin sheet to the east. It is recognized in the southern part of Dakota, and in Montana. In the Rocky mountains the

base of the formation is a heavy bed of sandstone, which is succeeded by sandstones and shales containing many coal seams. The maximum deposition during this period was west of the axis of the Rocky mountains. In the Elk River escarpment the formation measures 5,300 feet. East of this, at Blairmore, it is reduced to 740 feet. North, near Banff, it has a thickness of 3,900 feet; and in Moose mountain, east of the main range, there are only 375 feet. Northward, on the Bighorn, the thickness is about 2,000 feet. It would seem that east of the mountains the formation was not of great importance, owing to thinning of the beds. The fossils of the formation so far described are plants—ferns, cycads, and conifers.

'*Dakota*—

'In the mountains, above the coal-bearing sandstone, occurs a series of conglomerates and sandstones that have a newer flora. The measures are not distinctly coal-bearing, though a few thin seams are found. Fresh water conditions during this deposition prevailed in Dakota and Montana, and probably along the western margin; but northward, on the Athabaska river, the Tar sands representing a period contemporaneous with the Dakota of Manitoba, have a marine fauna.[1]

'The thickness of the formation in Manitoba cannot be much over 200 feet. In the foothills a thickness of 150 feet seems to represent the formation; but westward, in the Elk River valley, a much greater thickness of coarser material is found.

'*Benton*—

'Dark grey, almost black, shale of marine origin. In Manitoba, the deposit is about 175 feet in thickness. In the foothills it is over 700 feet; but this undoubtedly includes the overlying Niobrara . . . . . .

'*Niobrara*—

'In Manitoba, the formation consists of grey calcareous shales, which are an upward continuation of the Benton beneath. The thickness varies from 130 to 200 feet, though it is apparently much thicker in places. The upper part is rich in calcite, and is used in making a common grade of cement in Manitoba . . . . .

'*Eagle*—

'In the foothills the only exposure that can be correlated with the Eagle sandstone of Montana is a thin 50 ft. bed of light coloured sandstone.

'*Claggett*—

'The 'lower dark shales' of Dawson, in the Milk River region of southern Alberta—marine in origin, and holding fossils which are mainly the same as in the Pierre—have, in that locality, been given a thickness of 800 feet. In Manitoba, the lower part of the Pierre—the Millwood shales—may represent this deposition . . . . .

'*Belly River*—

'The Judith River formation of Montana is found to continue north into Alberta, and to constitute there the beds already called 'Belly River.' No exposures occur east of Saskatchewan; but if the divisional line between the two

[1] Ottawa Naturalist, Vol. XII, p. 37.

portions of the Pierre in Manitoba marks the horizon occupied by them, there may be found thin beds to the east of those known. The formation is represented in the north, on Peace river, by the Dunvegan beds. In Alberta it is described as consisting of two divisions: an upper, pale series; and a lower, yellow part. In the upper, brackish water molluscs are found, consisting mainly of fresh water deposits. The lower portion is distinctly yellowish in colour, and is mainly a brackish water formation.

'The rocks are sandy clays with shales and sandstones, and the total thickness of the formation seems to be 900 feet. The thickness of the part exposed in Alberta may be not far short of 900 feet, though it evidently thins out eastward.

'Coal seams occur in the upper or fresh water portion, and the fauna resembles very closely that of a Tertiary type in beds above . . . . .

'*Bearpaw*—

'The Pierre-Foxhill of the writers of the geology of Saskatchewan and Alberta is without doubt that portion of the Pierre which is above the Belly River formation; but since it has been shown that the typical Pierre embraced beds below this shallow water and land deposit, new names have been suggested by Messrs. Stanton and Hatcher—Claggett for the lower shales, and Bearpaw for the upper . . .

'In Manitoba, the upper part of the Pierre is called Odanah, and may represent the same time interval as the Bearpaw.

'*Edmonton*—

'The Laramie rocks of southern Saskatchewan are, over a large part, divisible into two distinct divisions. The lower one consists of about 150 feet of feebly coherent, greyish, and pure white clays, sandy clays, and sands with occasional beds of carbonaceous shales and lignites.[1] This lower unnamed part bears the same relation to the marine clays of the upper Pierre that the Edmonton of Alberta does, and is here correlated with it.

'In Alberta, the rocks of the southern part, described as Laramie, are divided into three divisions, and the lower part of the lowest member—the St. Mary River beds—is of about the same horizon as the Edmonton of northern Alberta. It is distinctly a series of light coloured clays and sands, and contains numerous coal seams. The deposits form a brackish water transition series between the marine clays of the upper Pierre or Bearpaw, and the Tertiary, or purely fresh water formation . .

'The thickness of the formation varies, but attains a maximum of 700 feet in central Alberta.

'*Tertiary*—

'*Paskapoo*—

'This series consists of fresh water deposits, generally of yellowish sandstones and bluish-grey and olive sandy shales. It embraces the upper part of the Laramie of southern Alberta and Saskatchewan, with a total thickness of about 5,700 feet. The remains of plants are numerous, and denote a flora of a temperate climate . . . . .

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[1] Annual Report, Vol. I, 1895, p. 67 C.

'*Miocene*—

'Isolated exposures of coarse-grained material deposited on the eroded surface of the Laramie (in northern Alberta the Paskapoo series) have been found to contain a considerable number of mammallian bones. These beds are characterized by the great quantity of waterworn pebbles derived from the quartzites of the Rocky mountains.'

From this general description, it will be seen that the Cretaceous rocks which underlie almost the whole of Alberta have as their basal member, where exposed on the plains, the Dakota sandstone, a porous rock and a suitable reservoir for oil. It, in turn, along its exposed (northern and eastern) borders at least, rests upon the Devonian, and is overlain by shales that would form an impervious cover which might retain any oil that found its way into the Dakota sands.

The Dakota sands are exposed along the Athabaska river and elsewhere in the north, where they are charged with tar to the extent of 12 per cent of the whole mass. The tar represents the residuum of petroleum which has escaped to the air along the exposed edges of the rocks. Natural gas and some petroleum are still escaping. McConnell[1] estimates the area of Tar sands seen by him to amount to 1,000 square miles, which with an estimated thickness of 150 feet, would give 28·4 cubic miles of Tar sands, or 6·5 cubic miles of tar, equal to 4,700,000,000 tons of bitumen. Of course, the Tar sands have not been fully explored. A large amount of oil has escaped, but it is altogether improbable that this process has gone on indefinitely and that all has been drained off, for the hardening of the oil to tar effectively seals the openings for escape, and only the area near the exposed edges is likely to have lost its oil content. That the distribution of oil is probably extensive, is indicated by the finding of tar in sands near the surface, far to the south, in the Edmonton country, apparently formed by the limited escape of oil from minor fractures in the rocks. Oil seepages also occur in southwestern Alberta, in South Kootenay pass, and the Flathead valley.

Southward from the northern edge of the Cretaceous, the covering of later Cretaceous formations over the Dakota sands becomes thicker. One of these formations, the Belly River, is thick and lens-shaped, and Calgary is just about over the centre of the lens. Most of the borings have been put down near the railways where, except in the east, the Dakota sands are far below the surface, and have failed to reach this, presumably, oil-bearing horizon. The best place to test is, of course, in the north, where the covering over the Dakota sands is thinner, and where the presence of oil is indicated by tar in the sands, yet the spot chosen should be far enough back to be beyond the influence of the leaks along the exposed edges. The Geological Survey put down three test holes, one at Victoria, one at Athabaska Landing, and one at Pelican rapids. The latter represented the best judgment of the Survey as to the location of a test hole. The two former, about 1,800 feet deep, failed to reach the Dakota owing to the great thickness of the cover at these points. Farther north, the Pelican well, at a depth of about 800 feet, reached the top of the Dakota and struck a tremendous flow of gas. Pushed 20 feet farther, it struck another heavy gas vein and some oil. The escaping gas froze the oil on the drilling tools and pre-

[1] Report on a portion of District of Athabaska, 1893, p. 65 D, G.S.C. Ann. Rep., Part I, Vol. V, 1900-1.

vented further progress, so that the Dakota sands were not proved as to their containing commercial reservoirs of oil. None of the wells sunk about Medicine Hat, Edmonton, or Calgary, have penetrated deep enough to test the oil possibilities. The two Calgary wells, sunk to 3,400 feet each, were still considerably above the Dakota, and separated from it by impervious shales, but here the upper Cretaceous rocks are exceptionally thick.

In southwestern Alberta, in the Pincher Creek district, oil is being prospected for in two areas, on the south branch of the south fork of Oldman river, and on Oil creek, a tributary of Waterton lakes. The Survey has done no recent work in this district, but in the first field the rocks are, so far as can be learned, Cretaceous. The rocks on Oil creek were regarded by Dawson as Cambrian, a view which Daly supports, but Dr. Walcott, of the Smithsonian Institution, believes them to be pre-Cambrian—corresponding to the Belt terrane of Bailey Willis. On Oil creek a green schist is exposed from which there is a seepage of oil. The oil has a paraffin base, is of excellent quality, and free from sulphur. The Pincher Creek Oil Company has two shallow wells in this shale which have not been shot. These yield ½ to 2 barrels of oil per day, according to information deemed reliable. As this shale outcrops at the surface, apparently over a fairly wide extent of country, it would seem that by sinking a number of shallow wells into it and torpedoing them to form catchment basins, a considerable quantity of oil might be collected from it. Three other companies are prospecting here: one has a well down 1,020 feet, which is stated to have yielded at the outset 300 barrels per day. A second well, at a depth of 1,170 feet, is estimated by the drillers to be capable of producing 25 barrels per day. These wells have not yet been shot. Three companies are prospecting on the south fork of Oldman river: one has three holes down, the deepest of which is reported to be down 1,400 feet.

These districts lie within the front range of the mountains. Some uncertainty as to the oil prospects of this section is introduced by the occurrence of heavy overthrust faults which may have allowed oil reservoirs that once existed to drain off. Outside the mountains near Pincher Creek, an anticline, parallel to the mountains, appears to exist. While this structure is favourable for oil reservoirs, the thickness of the upper Cretaceous rocks presents difficulties, and there is a possibility that the Fernie shales and Carboniferous rocks may extend out from the mountains and form an impervious blanket which prevented the oil from reaching the Dakota horizon. The driller should be prepared to go as deep as 3,500 feet, and the soft shales, etc., of the upper Cretaceous present many difficulties in such deep boring. At Calgary borings would probably have to exceed 4,000 feet to test the possibilities of the district.

Near Edmonton the thickness of the rocks above the Dakota is not definitely known, but it is probably considerably over 2,500 feet, as the holes at Athabaska Landing and Victoria, 1,800 feet deep, did not penetrate to the Dakota, and at both these points the thickness of the overlying formations is less than at Edmonton. In the vicinity of Pelican rapids a hole about 1,000 feet in depth is required. Eastward the Cretaceous also thins out, so that at Medicine Hat holes of 1,800 to 2,000 feet in depth would probably reach the Dakota.

Natural gas seems to be widespread and to be present in large quantities. Productive gas wells have been drilled in the east at Dunmore Junction, Medicine Hat, Stairs, Suffield, Langevin, Bassano, and Bow Island. The surface rocks belong to the Belly River formation, and the gas veins are encountered in sandstone bands in the Niobrara shales. The gas horizons are tapped at depths of about 700 and 1,000 feet.

The Dakota has not yet been penetrated, but will probably be prospected in the near future.

Farther west, at Bow Island, on the Crows Nest railway, a well over 1,900 feet deep, which was drilled last spring, gives a flow of gas reported to be 8,000,000 feet per day, with a rock pressure of 800 pounds to the square inch.

In the north, on the Athabaska, natural gas is escaping along the banks of the river. In the Pelican Rapids well, about 180 miles north of Edmonton, an enormous flow of gas was encountered at the top of the Dakota.

The presence of immense tar fields along the outcropping edges of the Dakota in the north; the occurrence near Egg lake and other points near Edmonton of Tar sands which seem to have been formed by oil escaping from fissures; the oil seepages from the disturbed rocks in the mountains of southwestern Alberta, and the heavy veins of gas encountered by boring in northern and eastern Alberta, warrant the belief that good oil fields may be found in Alberta. The best points to prospect would appear to be: in the south, near Pincher Creek (where it would be necessary to be prepared for deep drilling); in the east, where it would be reasonably sure that gas, at any rate, would be struck, or in the north at about the latitude of Pelican rapids, where test holes would not have to be deep, and where the Dakota is known to have had large supplies of oil. The neighbourhood of Pelican rapids would be far enough back from the outcropping edges to find sand that may not have been drained of its oil. The proposed railway to Fort McMurray would render this district accessible.

About Fort McMurray and north of that point, the Devonian is exposed without a Cretaceous cover. Although the oil, which formed the Tar sands of the Dakota, probably came from the Devonian, and although the Devonian almost everywhere in the Mackenzie valley is more or less petroliferous, there are no grounds for supposing that the Devonian would be a particularly favourable formation to prospect, for oil escapes so readily, and in this case is known to have escaped in such quantities that it is uncertain that commercial reservoirs have been retained. It cannot, however, be stated that an undrained oil horizon does not exist in it, but only that prospecting in it is a gamble. If oil were found in the Dakota about Pelican and some information gained as to its distribution, prospecting could be continued southward, in the districts where deeper drilling would be necessary, with the element of chance to some extent eliminated.

KOOTENAY COAL IN NORTHERN ALBERTA.

Samples of coal, with accompanying fossils, were brought down by Mr. J. R. Akins, of the Dominion Lands Branch, from Smoky and Muskeg rivers, north of the Grand Trunk Pacific railway. From these it appears that a basin of Kootenay coal-bearing rocks occurs in this latitude. This is the coal formation which carries the

high grade bituminous and anthracite coals of the Crowsnest pass, and Bow River valley, and it is important to find it extending so far north. The points from which the samples were obtained are in the neighbourhood of lots 3 and 4, township 57, range 7.

The reports of the officials of the Survey concerning the more important features of their work during the year are herewith appended.

THE WHEATON RIVER DISTRICT, YUKON TERRITORY.

(D. D. Cairnes.)

INTRODUCTION.

The season of 1909 was devoted to mapping and geologically investigating a portion of southern Yukon, extending 5 to 7 miles on each side of Wheaton river, commencing 6 miles above its mouth at Lake Bennett, and continuing over 20 miles up stream. This tract flanks the Coast range of mountains on their eastern side; while its southern edge is from 12 to 15 miles north of the 60th parallel of latitude (the British Columbia-Yukon boundary).

During the summer of 1906 I surveyed and examined a portion of the Conrad and Whitehorse mining districts,[1] including Windy Arm and the mining properties in the vicinity, and the lower stretches of Wheaton river. Since this was completed, a large number of mineral discoveries have been made along this latter stream. Some are situated in the western part of the area described in the above-mentioned report; but the majority are farther west. In fact, promising showings are to be found in various places, nearly to the headwaters of the Wheaton. The belt investigated during the past season includes all the known promising mineral properties south of the Whitehorse Copper Belt, and east of Windy Arm and the White Pass and Yukon railway.

Claims have been staked in nearly all parts of the district surveyed this past season, and, in spite of the extremely small amount of assessment or development work of any kind that has, in most places, been performed, several properties present a very encouraging appearance. Considering how slightly the district has been prospected, it is somewhat remarkable that so many deposits of ore have been found; and it is improbable that the best, or more than a small portion of all the valuable deposits has yet been discovered.

As soon as transportation charges on the railway have been reduced, so that outfits and supplies may be obtained at a more reasonable cost, and ore and concentrates shipped out at a moderate rate, there can be little doubt that prospecting and mining will be stimulated, resulting in a number of these properties becoming important producers.

A base-line, about two miles long, was measured along a tangent on the White Pass and Yukon railway, commencing about half a mile north of Robinson. From this base a triangulation was carried over the district. The topography was filled in chiefly by the photo-topographic method, aided to some extent by plane-table traversing. This latter method was also employed in surveying all roads, trails, etc.

During the season, I was assisted by E. W. Banting, B.A.Sc., and W. A. Bell, who performed in an efficient manner the greater portion of the topographical part of the work. Mr. Bell also assisted, at times, in the geological work.

GENERAL CHARACTER OF THE DISTRICT.

Topography.

The district described in this report is included in the western portion of the Yukon plateau, and extends westward to the eastern edge of the Coast Range moun-

[1] Cairnes, D. D., Geol. Surv., Can., Report on a Portion of the Conrad and Whitehorse Mining Districts, Yukon Territory.

tains. This plateau province, which has been described in previous reports,[1] is strikingly developed along the Wheaton river. It is quite evident that the rolling expanse of almost featureless upland is a portion of a recently unlifted, and subsequently, deeply dissected, almost base-levelled surface. The general level of this elevated tract is from 2,500 to 3,000 feet above the main intersecting stream beds, or 5,750 feet above sea-level. Occasional monadnocks, or generally rounded hills, rise in places above the surrounding expanse of upland, and constitute the only considerable inequalities which subaerial erosive agencies have left to break the monotony of the planated surface. The geological formations have no relation to, and do not accord with, the land surface, the formations being, as shown farther on in this report, of various origins, ages, textures, attitudes, etc.

The walls of the main valleys are generally steep, forming almost perpendicular declivities at numerous points. This feature of the topography has been accentuated and produced, in some instances, by glacial action. The main ice masses occupied these depressions and were effectual in straightening them and planing the slopes, and in widening and lowering their floors; causing the valleys to be wide, deep, and steep-sided. The smaller tributary streams flow with gentle gradient in wide, shallow depressions, over the upland surfaces, but generally plunge suddenly over the edges, by a succession of falls, through ravine-shaped incisions, to join the main streams below.

Numerous well defined terraces, at various elevations up to 700 or 800 feet above the stream beds, extend along the Wheaton valley and along Partridge pass, Becker creek, and others of its main tributaries.

Below the Big Bend of the Wheaton, the river valley has an average width of about one mile. Above the Big Bend, however, it is generally only one-quarter to half a mile wide. The stream itself is still active, removing the glacial gravels, sands, clays, etc., which, at one time, filled the valley to a depth of several hundred feet. The river channel is exceedingly tortuous, the course of the stream being easily altered in these slightly resistant glacial materials. The valley walls rise abruptly 2,500 to 3,000 feet on each side.

Flora and Fauna.

The district is but sparsely forested: trees and shrubbery growing principally in the valley flats, and seldom extending up the hillsides more than 700 or 800 feet above the main depressions. The only trees of any considerable size are the white spruce (*Picea alba*); black pine (*Pinus Murryana*); and balsam fir (*Abies subalpina*); the spruce being by far the most plentiful. Some good groves of the latter species, straight and well grown, were noted in the valleys, the trunks seldom being larger than 12 inches in diameter, 3 feet from the ground. Black pine is occasionally found interspersed with the white spruce, or at times forming separate groves, either in the valleys or on the hillsides. The balsam fir is generally on the slopes near timber line. The two latter varieties seldom have more than a 10 inch stump. Willow (*Salix*); dwarf birch (*Betula glandulosa*); aspen poplar (*Populus tremuloides*); balsam poplar (*Populus balsamifera*); and western balsam poplar (*Populus trichocarpa*); cover a considerable portion of the valleys, and are found on the majority of the sidehills up to an elevation of 4,000 feet above sea-level. The dwarf birch, in places, also extends to the main plateau line.

Several varieties of wild fruit were noted in the district: mossberries; high-bush cranberries (*Viburnum pauciflorum*); and low-bush cranberries, were quite plentiful

1 D. D. Cairnes—Report on a Portion of the Conrad and Whitehorse Mining Districts, Yukon.

Summary Reports of the Geol. Survey Branch—1906, 1907, 1908.

in places, also black currants (*Ribes Hudsonianum*); red currants (*Ribes rubrum*); *gooseberries*; blueberries (*Vaccinium*); strawberries (*Fragaria cuneifolia*); raspberries, and Saskatoon berries (*Amelanchior florida*) were noted.

Moose and sheep are fairly plentiful in many localities, as are also black, and grizzly bears. Caribou are less often seen. Wolves, wolverine, beaver, otter, marten, and lynx, are somewhat common. Cross, black, and silver foxes are also occasionally found. Ptarmigan exist in great numbers on the higher elevations, and grouse of different varieties are fairly plentiful. Rabbits, which a few years ago were so abundant, are now very scarce.

The streams and lakes are generally well supplied with grayling and trout.

Climate.

The climate of southern Yukon is similar to that of many districts in British Columbia and other northerly but prosperous mining camps of the world, and in actual mining few more climatic difficulties have to be overcome, here, than in localities farther south. All necessary outside and surface work in connexion with mining and similar industries may be continued at least six months in the year. Besides, on account of the very long days at this northern latitude, surface work may be performed during a considerable part of the summer by night as well as by day, without the aid of artificial light. The ground, in many places, is continually frozen to varying depths, but this does not interfere with mining operations, except while work is being done at or near the surface.

The rivers generally open early in May, but on some of the lakes the ice remains until the first week in June. Slack water stretches freeze over any time after the middle of October, but occasionally the rivers remain open until well on in November.

Transportation and Communication.

Two wagon-roads have been built from Robinson, on the White Pass and Yukon railway. One leads to Gold hill, a distance of 20 miles,, and the other, which is over 30 miles long, extends up Wheaton river. From these and branch roads, which can readily be constructed, access can be had to all parts of the district, the different mining claims being from 12 to 35 miles distant from the railway. A road could also easily be built, if necessary, down the Wheaton valley to Lake Bennett, along the eastern side of which the railway has been constructed. There is also an exceptionally good grade for a railway, to near the headwaters of Wheaton river, from either Robinson or Lake Bennett. The White Pass and Yukon railway connects at Skagway with lines of boats sailing to Vancouver and Seattle.

GENERAL GEOLOGY.

The geology of this district is somewhat complex, and many types of rocks are represented, including sedimentary, metamorphic, volcanic, and plutonic. Highly altered schists, gneisses, and limestones, as well as more recent andesites, have been extensively invaded by granitic rocks. This complex is overlain by Jurasso-Cretaceous sediments which have been intruded, and, in part, buried in turn by andesites, andesitic tuffs, eruptive breccias, granite and syenite porphyries, and basalts. Newer than all these is a widespread series of trachytes, rhyolites, tuffs, and breccias, which are hidden in places by superficial deposits.

TABLE OF FORMATIONS.

Quaternary	Superficial deposits	Gravels, sands, silts, clays, volcanic ash, etc.
Pleistocene and late Tertiary	Wheaton River volcanics	Rhyolites, trachytes, tuff, breccias, etc.
	Carmack basalt	Basalt and basalt tuffs.
	Klusha intrusives	Granite and syenite porphyries.
	Chieftain Hill volcanics	Andesites, tuffs, and breccias.
Jura-Cretaceous	Tantalus conglomerate	Chiefly conglomerates with some sandstones, shales and coal seams.
	Laberge series	Conglomerates, greywackes, sandstones, shales, etc.
Jurassic	Coast Range intrusives	Granites, granodiorite, and diorites.
	Perkins volcanics	Andesites and andesitic tuffs.
Lower Palæozoic or older	Mt. Stevens series	Schists, gneisses, and limestones.

Mount Stevens Series.—The oldest rocks comprise a series mainly of chloritic, sericitic, and greenstone schists, schistose quartzites, limestones, and gneisses. The schists are chiefly fine-grained, greenish, cholritic rocks, varying in structure from highly fissile to but slightly schistose. The sericite schists are generally soft and friable, yellowish to greyish in colour, and finely foliated in structure. The greatest thickness of limestone beds occurs on Schist mountain, where they have an aggregate thickness of approximately 700 feet; the rock varying from white to bluish, and from subcrystalline to crystalline. The most prominent gneisses are fine-grained mica gneisses and coarsely crystalline rocks presenting the appearance of crushed gabbros. All these rocks, which are believed to be of lower Palæozoic age or older, have been much altered and plicated, and occur in the form of small isolated areas brought up as infolds in the newer rocks—chiefly in the granites. A considerable portion of the ores of the district occurs in the schists of this series.

Perkins Volcanics.—More recent than the Mount Stevens group is a very homogeneous series, the Perkins series, consisting chiefly of considerably altered, hard, fine-grained, dark-greenish, andesites and andesitic tuffs.

Coast Range Intrusives.—Invading both of the above-mentioned series are numerous outlying areas of the granitic rocks of the Coast Range batholith, believed to be of Jurassic age. These rocks are generally fresh and unaltered in appearance, predominantly greyish in colour, and under the microscope prove to be generally granodiorites. In places they are quite porphyritic—feldspar phenocrysts 1½ to 2 inches long having been frequently noted. The greater number of the quartz veins of the district are found in these granitic rocks.

Laberge Series.—Newer than the granites are the rocks of the Laberge series of Jurasso-Cretaceous age, which consist of shales, sandstones, greywackes, conglomerates, and breccias. These beds are similar to those seen along Lake Laberge and elsewhere in the Braeburn-Kynocks and Tantalus coal areas. Medium textured, greenish-grey, heavily bedded greywackes frequently alternate with fine-grained shales and slates. The conglomerates consist chiefly of volcanic materials, the component pebbles and boulders—which are as much as 6 inches in diameter—being usually firmly cemented together. It is in the greywackes of this series that the ores of the Union mines have been deposited.

Tantalus Conglomerate.—Resting conformably on the Laberge beds are those of the Tantalus conglomerate series, which have here an aggregate thickness of 300 to 400 feet. These conglomerates, etc., which are associated with all the bituminous and

anthracitic coals so far discovered in southern Yukon, have been described in the author's previous reports on this territory. The series consists chiefly of generally dark coloured, heavily bedded conglomerates, the component pebbles of which consist entirely of chert, quartz, and slate. Associated and interbedded with the conglomerates are a few beds of sandstone and shale, and coal seams. The sandstones are composed, chiefly, of the same materials as the conglomerates, but in a more finely-divided state. The shales vary from light grey to almost black, are generally thinly laminated, and grade into typical slates.

Chieftain Hill Volcanics.—Cutting all the above-mentioned formations is a series of mica-hornblende, and augite andesites, andesitic tuffs, breccias, etc. They occur in some places chiefly as dikes, but in others form quite extensive sheets and flows. They vary from mica andesites, with greenish-grey to reddish ground-mass, in which are well defined plagioclase and biotite phenocrysts, to fine textured, dark green basaltic-appearing augite andesites. They correspond to, and include the members of, the Schwatka and Hootchi series of the Braeburn-Kynocks and Tantalus coal areas; but the characteristics that served to distinguish these formations in these latter localities are not here in evidence.

Klusha Intrusives.—Newer than these andesites are numerous dikes of granite and syenite porphyry, from 4 or 5 feet to several hundred feet wide. These are generally light grey, coarsely crystalline rocks, and correspond to the 'Klusha Intrusives' of the Lewes and Nordenskiöld Rivers coal districts.

Carmack Basalt.—Dikes and sills of a medium textured, dark coloured basalt, occur in numerous places, and cut all the above-mentioned formations. This basalt is similar to that seen to the north, in Miles cañon, and at other points in the vicinity of Whitehorse, also in the Tantalus coal area, farther north, and has, in the latter district, been included in the 'Carmack Basalts.' These rocks and the Klusha intrusives are considered to be of late Tertiary age.

Wheaton River Volcanics.—The most recent consolidated rock formation of the district consists of a series of trachytes, rhyolites, tuffs, breccias, etc. These are prevailingly light yellow in colour, becoming reddish in places owing to the oxidation of small particles of iron pyrites. They are generally soft, and weather and decompose readily, breaking, as a rule, into thin slabs. The mountain slopes on which these rocks outcrop—when seen from a distance—are bright yellow or red in colour, and are invariably covered with talus.

Superficial Deposits.—The main valleys in this district are floored with glacial deposits, which generally reach well up on the hillsides, extending in places even to the higher elevations. The channels of the main streams are entirely in these gravels, sands, tilts, etc., insufficient time having elapsed since their deposition for the water to remove them from these depressions. In fact, some of these principal pre-glacial waterways are still completely filled with such material. Overlying these Pleistocene deposits are more recent accumulations, composed of fluvial and littoral sands, gravels, and silts of the present waterways; muck, volcanic ash, and soil. The volcanic ash, which has been mentioned in nearly all reports on any portion of southern Yukon, is a notable feature in this district, consisting of a single, very evenly distributed and widespread layer, which is 3 to 6 inches thick along Wheaton river, and evidently due to one continuous, but short period of outburst. It is much more recent than the silts—the most recent of the glacial deposits; in fact, it is almost at the very surface, the grass roots extending down into it.

ECONOMIC GEOLOGY.

With the exception of some coal seams found in one locality, this district, from the standpoint of economic geology, is of interest chiefly for its ore deposits. These might be arranged under three classes:—

(1) Quartz veins generally carrying galena, and in places, telluride minerals, chiefly sylvanite and telluric ochre. Arsenopyrite, zinc blende, pyrite, grey copper, bornite, chalcopyrite, malachite, azurite, etc., may or may not be present in small amounts.

(2) Fissure veins composed chiefly of stibnite with inferior amounts of zinc blende, in either a quartz or a calcite gangue.

(3) Contact deposits.

Deposits belonging to this last class have been found only on one property; but the veins occur in all parts of the district, those carrying antimony minerals being, however, limited to the extreme southwestern portion of the area.

The mining properties are here considered in order, from east to west.

Union and Nevada Mines.

The Union Mines properties were located a number of years ago, and a general description of them has already been published.[1] They are situated on the east face of Idaho hill, and consist of three claims on which are a number of nearly parallel veins occupying fissures in a fine-grained, greenish-grey greywacke. The majority of the veins have a general strike of N 67° W,[2] and dip from 60° to 80° to the southwest. Ten veins in all were seen, having an average width of 4 inches to 12 inches; and others probably exist. The minerals are chiefly galena, arsenopyrite, zinc blende, pyrite, and chalcopyrite, and occur in a quartz gangue. Several veins from 8 inches to 10 inches thick, and highly mineralized with galena, arsenopyrite, and zinc blende, were noted. The thickest discovered is 2′–6″, and consists, on the surface, of decomposed material, chiefly quartz, pyrite, and galena. These ores generally carry some gold, but are chiefly of value for their silver and lead contents. All the work performed on these properties is of the nature of surface prospecting.

The Nevada Mines are a group of claims adjoining the Union mines. Several quartz veins showing some arsenopyrite, pyrite, galena, and zinc blende, have been found in them, and, to some extent, have been developed.

Stevens Mountain Claims.

The Buffalo Hump Group, owned by Mr. Geo. Stevens, and consisting of the Sunrise, Golden Slipper, and Wheaton—all located on the north side of Stevens mountain—are probably the most widely known claims in the vicinity.

On the *Golden Slipper* claim, several hundred pounds of very rich quartz have been found, containing free gold and sylvanite. Although, when visited in August, the surface had been prospected somewhat carefully and a drift 85 feet long, with a 20 ft. cross-cut had been driven, the source of the high grade float ore had not been discovered. The formation is chiefly granite.

On the *Sunrise* claim is a 7 ft. quartz vein in a fissure in granite, which carries some galena and free gold. Little prospecting has been done here, hence it is not known, even approximately, how much gold and silver the average quartz carries.

On the *Acme* claim, owned by O. Dickson, is a lenticular quartz vein, in chloritic schist, the quartz being in one place over 30 feet thick. It appears, however, to be very slightly mineralized.

On the *Hawk Eye* group of three claims, owned by the 'Tally-Ho Boys,' and situated on the Wheaton River slope of Stevens mountain, are two quartz veins averaging 20 inches, and 3 to 4 feet, respectively, in thickness, which have been prospected to some extent.

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[1] Cairnes, D. D.—Report on a portion of the Conrad and Whitehorse Mining Districts, Yukon.

[2] All bearings in this report are astronomic, or true, the magnetic meridian being generally about 33° to the east of the astronomic.

On none of these claims on Stevens mountain has ore been found in place so far, rich enough to pay for mining. Still, extremely rich float has been found near the summit of the hill in several places; and from the size, angular character, and amount of the material, it is quite evident that it has come but a short distance, and belongs to the hill on which it is found; so that it is hoped that the vein or veins from which it is derived will be discovered.

Big Bend Mountain Claims.

The *McDonald Fraction*, which is situated near the western edge of Big Bend mountain, is probably the best appearing prospect on this hill. Outcropping on it, and occupying a fissure in granite, is a 2 ft. vein of quartz, well mineralized, chiefly with argentiferous galena, which, it is claimed, contains gold and silver in very encouraging amounts.

The *Silver Queen and Gopher* claims are on the west side of Big Bend mountain, near the McDonald Fraction, and are the principal claims in a group of seven, owned by the 'Tally-Ho Boys.' On the former is a 3 ft. vein of quartz in granite, and on the latter in greenstone schist is a lenticular vein, which, at one point, is as much as 7 feet thick. These veins are reported to carry important amounts of gold and silver.

The Tally-Ho Group.

On the west side of the Tally-Ho gulch, which extends along the western end of Big Bend mountain, the 'Tally-Ho Boys' have located eight claims. The development work, for this group, all of which has been performed on one claim, consists of a 250 ft. drift; a 10 ft. winze; a 40 ft. raise, and a cross-cut about 15 feet long. The ore occurs in a brecciated fault zone 4 to 5 feet wide in the granite formation, and consists of a quartz gangue impregnated with galena, the quartz varying in width from 2 inches to 4 feet. Of five assays of samples taken by the author, the average was close to $80 per ton in gold and silver.

Becker Creek Claims.

On the east side of Becker creek, and on the west face of Anderson mountain, is a strong, well-defined quartz vein, 4 to 5 feet wide, contained in a fissure in granite. The strike of the vein is, approximately, N 68° W, and its attitude is nearly vertical. It can be traced nearly the entire length of the Rip and Wolf claims, and, in most places, is well mineralized with argentiferous galena. A basalt dike 2 feet wide has split the vein, and continues in it, for at least 2,000 feet.

On the *Rip* claim, owned by Wm. McGrew, a drift 90 feet long has been driven on the vein, the basalt dike in this distance crossing from one side of the ore to the other. The quartz obtained here should pay to work even under present conditions.

On the *Wolf* claim, owned by Messrs. Clark, Dickson, and Johnson, the basalt dike splits the vein into two about equal parts. Approximately 40 feet of open-cutting and drifting have been performed on this property.

The *Fleming* claim, located in July, 1909, by Mr. H. E. Porter, is situated on a small hill on the west side of Becker creek, and facing the Wheaton river. Here, certain beds of gneiss, which constitute a portion of the old pre-Ordovician series, have been more or less replaced by quartz, calcite, epidote, garnet, hematite, magnetite, pyrite, and chalcopyrite with its oxidation products azurite and malachite. The schists strike N 42° W, and dip at 60° to 70° to the northeast. To such a degree has the replacement proceeded that for a width of 30 feet, one schist band has been almost entirely altered to iron and copper minerals, with some epidote, quartz, etc. The 30 feet probably average about 1 per cent copper. Other similar but narrower bands were noted.

The origin of the ore is almost certainly directly due to the invasion of the granites which outcrop along the south side of the hill.

Claims on Gold Hill and Vicinity.[1]

Considerable excitement was caused during the season of 1906 by the finding of quartz carrying free gold and telluride minerals on what is now the Gold Reef claim on Gold hill—midway between the Watson and Wheaton rivers, and 20 miles southwest of Robinson.

Since 1906, considerable development has been conducted on the *Gold Reef*; but only a few pockets, from the size of a man's head, to one of 500 or 600 pounds of the rich ore—which contains free gold, sylvanite, hessite, and telluric ochre—have been found: elsewhere, the vein, which is 4 or 5 feet wide, is almost barren, containing only occasional disseminated particles of pyrite, and but slight amounts of gold and silver.

Of the large number of other claims which were located in this vicinity in 1906, the only one on which any development work, other than assessments, has been performed is the *Legal Tender*. The vein on this property is in a fissure in granite, and is 3 feet to 3'-6" thick, and consists of a quartz gangue in which are disseminated particles of argentiferous galena and chalcopyrite. The ore is claimed to have an average value of $40 per ton. A 100 ft. drift has recently been driven on the vein.

During a recent assessment on the *Lucky Boy* prospect, a quartz vein—at least 7 feet wide—was uncovered, which carries some copper glance, chalcopyrite, and malachite. As the vein is only stripped for a distance of 6 feet, very little information concerning it is available.

Carbon and Chieftan Hills, and Vicinity.

A number of claims were staked on these hills during the season of 1893 by two prospectors: Frank Corwin, and Tom Kirkman; who, during the season, did considerable prospecting work on them. These men did not return again, and the ground remained vacant until rediscovered in August, 1906, by Mr. H. E. Porter, who located eighteen claims on the hills. This caused a general stampede to the vicinity, resulting in the staking of a great number of claims.

A large proportion of these claims, located during this rush, are still held, but on only a few has any work, other than assessment, been performed.

Mr. Porter and Mr. William J. Fleming, of Chicago, own three claims on Carbon hill, namely, the Porter, the Empire, and the Excelsior, which have recently been surveyed. On the Empire are the old workings—now caved in—of Corwin and Kirkman. On the Porter claim a drift is being driven to cross-cut a number of parallel veins, and when measured on August 20, was in 160 feet. The veins which are all in fissures in granite, strike about N 77° W. and dip from 40° to 50° to the northwest. The best appearing one of theses varies from 14 inches to 3 feet in thickness; can be traced over 200 feet on the surface, and has every appearance of extending much farther. The ore appears to be chiefly stibnite and sphalerite, in a quartz gangue. In places there are 12 to 14 inches of stibnite, with very little gangue mineral. Five feet below this vein is another, from 6 to 12 inches thick, and similar to the former, but not so highly mineralized. There are also two other veins within a few feet, which are from 2 to 6 inches wide, and consist of quartz with small disseminated particles of galena and grey copper, and, apparently, no antimony minerals. Samples from these two veins have assayed as much as $80 per ton in gold and silver. In a gulch on the north side of Carbon hill, Mr. Charles Goddell has located some claims on two parallel veins which are not more than 20 or 30 feet apart, and are exposed

[1] D. D. Cairnes—A Portion of the Conrad and Whitehorse Mining Districts, Yukon.

for over 2,000 feet. These strike N 80° W, have an almost perpendicular attitude, consist chiefly of quartz carrying some stibnite and arsenical iron, and are 2 feet, and 2 to 6 feet thick, respectively.

Besides the above-mentioned, a number of other veins from 6 inches to 2 feet thick, were noted. These are more or less highly mineralized, chiefly with antimony minerals, and occur, not only in the granite, but also in the overlying sedimentaries.

The two main claims on Chieftain hill are the Morning—owned by Messrs. Anderson and Eisenhauer; and the Evening—owned by Messrs. Dixon and Johnson. These properties are located on the same vein, which, near where it crosses Chieftain gulch, is 5 feet wide, and consists of quartz highly impregnated with stibnite; a portion of the vein—2 feet wide—being almost entirely composed of this mineral, which exhibits beautiful columnar and radiated structures. Fifty feet from this place, in each direction, the vein has narrowed to from 6 inches to 1 foot. This vein is in a fissure, in a fine-grained, greenish andesite; it strikes almost due east and stands nearly perpendicular.

Bush Mountain Coal Area.

The Tantalus conglomerates which, in the southern Yukon, are known to be coal-bearing, were found outcropping about one mile west of the Union mines, on the ridge joining Bush mountain and Idaho hill, and search was made for coal, which, if found in this locality, would be of considerable value. Three seams were discovered: one over 6 feet, one 18 inches, and one of unknown thickness, but at least 3 feet. There were indications of other seams; but as the ground was frozen and the coal deeply covered, to have made a section of the measures, or even to have determined the thickness of the different beds of coal, would have entailed a very considerable amount of work. The measures were traced from the summit of the ridge to near the valley bottoms of Schnabel and Follé creeks on the south and north sides respectively. These creeks are here two miles apart, and, opposite the coal, are about 2,000 feet lower than the summit of the ridge between them. The belt of coal-bearing formation is about half a mile wide, and the rocks comprising it are much folded and disturbed. The coal, which is bituminous, and of the same age as that at Whitehorse and Tantalus, should make a good fuel.

Quartz Claims East of Whitehorse.

After the close of the regular field season, a visit was made to certain quartz claims east of the Lewes river, near Whitehorse.

These claims are situated near the summit of one of the most southerly of the limestone hills in the range facing the town of Whitehorse on the east. The Lewes river, after flowing along the southern end of this range, turns suddenly at nearly right angles, and continues toward the north along its western face. Hence, the claims, being on the southwest corner of the range, are about equidistant from the river in either a southerly or westerly direction. They are about 8 miles in a direct line, or 12 miles by trail, in a southeasterly direction from Whitehorse; and the shaft on the Golconda claim is approximately 1,600 feet above the level of the town.

A good pack train, 7 miles long, has been built to these claims from Canyon City at the head of Miles cañon. Canyon City is situated on the east side of the Lewes river, on the opposite side of the river from, and five miles above, Whitehorse. A good grade is obtainable for a wagon-road from the claims to the river, either at Canyon City or other points above or below; the claims being nearest the river at points a few miles above Canyon City.

The claims themselves and the greater portion of the higher elevations in the vicinity are exceptionally well forested for this portion of the Yukon Territory. The principal timber trees are the white spruce (*Picea alba*), and balsam fir (*Abies salal-*

pina), the former being more abundant than the latter. Trees with 16 inch stumps were noted, and those with 14 inch to 16 inch stumps are fairly plentiful. The average, however, of the larger trees is not more than 10 inches in diameter, 3 feet from the ground.

There is also an abundant supply of water on the properties.

All the rocks seen on the claims and on the hills in the vicinity belong to the limestone series which outcrops so extensively along Tagish lake; in the neighbourhood of Whitehorse; along the Lewes river; and elsewhere in the southern Yukon. Although not positively proved, it has been supposed[1] that these rocks are of Carboniferous age. These limestones are, as a rule, very uniform, and generally appear as heavily bedded, subcrystalline rocks, varying from dark grey to almost white, but prevailingly light grey in colour. The chief impurities in them consist of small siliceous—at times cherty—aggregates. Rarely, beds of somewhat arenaceous or argillaceous material occur in the form of calcareous shales, and it is in a series of these that the quartz has been deposited, along which the Golconda group of claims has been located.

The Golconda group consists of four claims: the Golconda, Florence M., Concord, and Mohawk, all of which have recently been surveyed. The first two were located by Mr. Arthur Thompson in 1899, and are still owned by him. The other two have been located since and are owned by Mr. P. Campbell, of Whitehorse.

The quartz along which these claims are located occurs in a soft, friable, thinly-bedded, somewhat iron-stained, calcareous shale, which will often split into large flakes $\frac{1}{16}$ to $\frac{1}{8}$ inches thick. These shales have a total average thickness of about 100 feet, and are interbedded in the typical heavily-bedded limestones, which strike N 41° W and dip 40° to 50° to the northeast. Veinlets of quartz traverse these shales in all directions, the majority, however, following the bedding planes, and, in places, they become plentiful enough to form considerable masses of quartz. In places, a great part of the entire 100 feet is more or less invaded by these veinlets; individual stringers widening out occasionally to several feet thick. The greatest amount of quartz occurs near the centre of the shale belt, where for a width of from 6 to 26 feet it is almost free from rock; the material for a few feet on each side also consists to a greater or less extent of interlacing quartz stringers. This constitutes the Golconda vein, which can be traced the entire length of the four claims staked along it, which comprise the Golconda group.

The main group follows the general strike of the shale and limestone beds, and its dip appears to coincide with that of the enclosing strata.

The quartz, being much harder than the shales, weathers less readily, hence it stands out as a ridge from 4 to 12 feet high.

That the quartz is entirely confined to the shales and is not found elsewhere is, apparently, entirely due to the fact that, the solutions carrying the quartz found greater facilities for circulation through these soft, friable, thinly-bedded materials than through the more compact, heavily-bedded limestones. Moreover, the shales have, naturally, been more shattered, crushed, and broken than the stronger beds on either side; thus giving additional fractures and planes of circulation in the shale belt for the invading solutions.

Nearly all the work in this group has been performed on the Golconda claim, and consists chiefly of a vertical shaft, apparently 60 or 70 feet deep. The shaft may be somewhat deeper than this, however, as when it was visited it was impossible to see the bottom on account of water. A few small cuts, etc., comprise the remainder of the development work on the group.

Except close to the Golconda shaft the quartz is apparently entirely devoid of mineralization except for rarely seen particles of free gold and a slight amount of

[1] G. M. Dawson—Report of Progress, 1887.

R. G. McConnell—Report on Whitehorse Copper Belt, Yukon Territory.

D. D. Cairnes—Report on Portion of the Conrad and Whitehorse Mining Districts, Yukon.

pyrite, which, in weathering, gives the quartz in places a somewhat reddish appearance on the surface. Close to the Golconda shaft the quartz contains some disseminated particles of chalcopyrite, and its oxidation product malachite.

It is claimed that assays as high as $40 a ton in gold have been obtained from this quartz. I made, however, two carefully taken, average surface assays: one at the top of the Golconda shaft, and the other from a place on the Mohawk claim, where some work has been done. Large samples were taken, and carefully quartered down. These were assayed by the Mines Branch, and in each case the result gave only traces of gold and copper. The Mohawk sample ran only a trace in silver; but the one from the Golconda claim gave 0·11 ounces silver to the ton.

It is possible that these samples do the properties injustice, as it is well known how difficult or next to impossible it is, in the case of a vein of free-milling quartz, to obtain a correct estimate of its value from the results of a few samples. A great many samples must be taken, and, when possible, a few tons of the material treated, before it is possible to decide as to its worth.

WILLIAMS AND MERRITT CREEKS.

After completing the work in the vicinity of Whitehorse, a few days were spent on Williams and Merritt creeks, where recent copper prospects are attracting some attention.

Merritt creek empties into Lewes river on its left limit, five miles below Yukon Crossing; while Williams creek joins the river one mile farther down. These two creeks, for several miles from their confluence with the Lewes, have almost parallel courses, at practically right angles to this river. Yukon Crossing is about 155 miles from Whitehorse, measured along the Whitehorse-Dawson wagon-road, and 230 miles from Whitehorse, by the river, and is midway between Whitehorse and Dawson.

Merritt creek was formerly known as Merrice creek; and was so called after Homer Merrice, who discovered placer here in 1898. By a mistake, and believing it to be the original, the present name has been adopted. Williams creek is named after a prospector by that name, who was one of the first to locate on this creek in 1898.

During the season of 1898 these creeks were prospected for quartz and placer, for 25 miles from the Lewes river, and the old workings of this time can still be seen in many places. From then until 1907—when practically all the claims now being held were located—the district was unoccupied.

The only two rock formations which exist at all extensively in this district consist chiefly of granites and amphibolites. The latter are the older and are much altered, dark green, sheared eruptives, which consist chiefly of plagioclase and green hornblende, in nearly equal amounts. The schistose structure is generally quite pronounced; still, the rocks are practically never thinly foliated. The granites are generally greyish to pinkish, coarsely crystalline rocks. A thin section of a typical specimen examined under the microscope showed it to be composed chiefly of orthoclase, microcline, acid plagioclase, quartz, and biotite, with accessory apatite, titanite, and magnetite, and a great amount of secondary epidote and chlorite. In all probability, these granites belong to the series of granitic rocks composing the Coast Range batholith, which are generally considered to be Jurassic. The amphibolites lithologically correspond to certain pre-Ordovician rocks which have been studied in the vicinity of Dawson,[1] and elsewhere in the Yukon Territory.

The granites have invaded the amphibolites to such an extent that the outcrops of the two formations appear to be about equally extensive: tongues, dikes, and irregular-shaped masses of the former being found everywhere, where rock, in place, is to be seen.

[1] R. G. McConnell—The Yukon Gold Fields. Geol. Survey Branch, Canada.

The ore-deposits of this locality occur either at or near the contacts of these two formations, and are everywhere of the same character, consisting of veins of quartz impregnated with copper minerals, chiefly bornite, chalcopyrite, and malachite. Particles of free gold are also believed to have been found on one property. The only apparent reason for the quartz being always so near the contact is, that the mineralizing solutions which have deposited the ores have found easier places for circulation in these somewhat decomposed and fractured zones. The ores are apparently genetically connected with the granites, the ore-bearing solutions being an after effect of the intrusion of the granite mass.

The ores of the district are all of such a nature as to lend themselves readily to treatment by concentration.

All the claims and copper grants in the vicinity, on which any work has been performed, or on which any ore is known to have been discovered, were examined. The only ones, however, on which any considerable amount of ore was seen, or which, from their surface showings, give promise of being of value, are the Bonanza King, the Homestake, the Monte Cristo, and the Dawson. It is quite possible, and even probable, that there is a considerable amount of ore in this locality which has not yet been discovered, since the surface is, in most places, covered with superficial deposits.

The *Bonanza King* is situated about one mile from the Lewes river, on Nancy Lee creek—a tributary of Williams creek—joining the latter on its left limit. This property is one of eight claims comprising the Bonanza King group, owned by Messrs. J. Munroe, J. View, and M. H. Boulais. All the development work on the group has been performed on the Bonanza King and Dawson claims. The work on the Bonanza King consists of 150 feet of drifting and cross-cutting, and a 30 ft. shaft. The entrance to the drift is 250 feet above the level of the Lewes river, at the mouth of Williams creek; and the top of the shaft is 250 or 300 feet distant from the mouth of the drift, and 200 feet above it.

The shaft is sunk on a vein of quartz which is 6 feet wide at that point; but is lens-shaped and narrows rapidly in each direction. The vein is in granite, near its contact with the amphibolite, and carries considerable bornite, chalcopyrite, and malachite. Particles of free gold are also believed to have been found here. Two samples of the better mineralized portions of the vein, one taken near the surface and the other about 15 feet from the surface, were assayed, and gave, respectively, the following results:[1] (1) gold—trace; silver—trace; copper, 3·29 per cent; (2) gold—trace; silver—trace; copper, 4·21 per cent.

The vein in the drift occurs in the contact between the granites and amphibolites, and, where first encountered, is wider than elsewhere observed, having a width of 5 feet. It narrows to a few inches in a distance of 20 feet, in the direction in which the drift has been run. It was found, however, on the surface on a level with the drift, and at a distance of 50 feet from where first cross-cut, and has here a thickness of 3 to 4 feet.

Both the vein at the shaft and the one in the drift strike approximately in the same direction: N 45° W, but are not connected with each other. It is possible that other similar deposits exist along this contact, either between the two already found, or farther to the northwest.

The formation has here been considerably shattered and broken. One very prominent fault plane, indicating a displacement of considerable magnitude, was noted in the cross-cut and drift, having a strike about parallel to the strike of the veins. So that the faulting will serve to further complicate the working of these deposits.

An average sample of the 5 feet of quartz in the drift was assayed, and gave the following: gold, 40 cents; silver, 0·30 of an ounce; copper, 1·56 per cent.

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[1] All assays given in this report were made in Ottawa by the Mines Branch of the Department of Mines, Canada.

On the *Dawson* claim a 40 ft. drift has been driven on a quartz stringer in the amphibolites near their contact with the granite. The quartz, at the surface, was only 2 inches or 3 inches wide, but at the end of the drift was 18 inches. The ore is very similar to that on the Bonanza King.

On the *Monte Cristo* claim, which is also on Nancy Lee creek, and is owned by Messrs. Thompson and Granger, a vein has been discovered which, where exposed, has a thickness of 5 feet. Within a few feet of this are several parallel stringers a few inches wide. The vein filling consists chiefly of quartz, bornite, chalcopyrite, and malachite. The surface is covered, nearly everywhere in this vicinity, with drift and the products of weathering and decomposition, making prospecting very difficult; so that the chances of finding ore, at all, are but slight, even though there were a number of valuable veins on this and the adjoining properties.

An average surface sample of this 5 ft. vein was assayed, and gave as follows: gold, 20 cents; silver, 0·20 of an ounce; copper, 1·00 per cent.

The *Homestake* is one of six copper grants of 160 acres each, located on Merritt creek, and owned by Messrs. C. L. Johnson, Chas. Seagam, and I. B. Sanburn. The development work for the group has all been performed on the Homestake grant, which is located on the south side of Merritt creek, two and a half miles from the Lewes river. The valley of the creek at this point is 300 feet above the average level of the river, at the creek mouth, and the main workings of the property are about 150 feet above the creek bottom. There is a good grade for a road to this property, from the river, up Merritt creek.

The widest vein found on this property, and on which nearly all the development has been expended, is 6′–6″ wide, where it outcrops on the surface. A drift has been driven on it, which, including several cross-cuts run off it, has an aggregate length of 155 feet. The vein in the drift has a width of from 12 to 55 inches, and is in the greenish schistose rocks near their contact with the granite formation. Besides this main vein, other stringers up to 10 inches wide were encountered in the drift and cross-cuts.

The formations along the face of the hill have been considerably shattered and faulted, causing the veins in the drift and elsewhere in the vicinity to be often broken, rendering the working of them somewhat difficult.

The main vein in the drift strikes about N 83° E, and dips to the northwest at 45° to 55°. Outcropping along the face of the hill, and a few feet below the drift, is a connected series of elongated quartz lenses whose maximum width is 3 to 4 feet; which is traceable for over 200 feet, and strikes N 42° W, the lenses usually dipping at 80° to 85° to the northeast.

Higher up the hill four other veins have been uncovered, having, where exposed, widths of 14 inches, 16 inches, 2 feet, and 3′–6″, respectively.

The wider veins are often of a composite character; consisting of a zone of amphibolite, along the foliation planes of which, more or less quartz has been introduced. In the drift, where it is widest, the vein consists of a number of layers of schistose rock alternating with tabular masses of quartz, the two being in about equal amounts. In places, however, along this vein, and along others on this and neighbouring properties, the greater part of the quartz in a cross-section occurs in a single mass or lens; the lenses are, occasionally, connected, forming practically continuous veins for considerable distances.

An average surface sample from the 6′–6″ of quartz above the drift was assayed, and gave: gold, 20 cents; silver—trace; copper, 0·28 per cent.

An average sample was also taken of a number of large pieces of the better grade of ore from the different surface exposures on the Homestake property. This assayed: gold, $1; silver, 1·30 ounces; copper, 0·92 per cent.

The solid rock formations on the Homestake and neighbouring grants are nearly everywhere covered, and the finding of the quartz has been generally due to some such

fortunate accident as the finding of particles of quartz attached to the roots of an overblown tree. Since quartz has been found at so many points, with little bed-rock visible, it seems quite probable that a large number of veins would be exposed if the mantle of superficial materials could be removed.

THE SKEENA RIVER DISTRICT.

(W. W. Leach.)

INTRODUCTION.

The construction of the Grand Trunk Pacific railway from Prince Rupert eastward towards the Yellowhead pass is now well under way, and in consequence, much interest has been developed in the country through which the line will pass.

The activities of prospectors have been confined chiefly to those districts immediately tributary to the main line of the railway, with the result that, in the last few years, numerous promising discoveries have been made, including silver-lead, copper, and coal deposits. These now await the completion of the railway, when, with adequate transportation facilities (at present lacking), the owners of the various claims will be enabled to develop their properties at a much less cost than is at present possible. Until railway transportation is available most of the metalliferous deposits and all of the coal properties must of necessity lie idle or, at best, work on them must be confined to mere prospecting.

During the past year much attention has been paid to the silver-lead veins on Ninemile mountain, close to Hazelton, which previously had been overlooked; the mineral deposits and coal fields of the Telkwa river and Babine mountain being heretofore the centre of attraction.

A number of prospectors penetrated into the country lying north and east of Ninemile mountain, and many silver-lead claims were staked; while on Babine lake a few copper locations were recorded. No analyses have been made this year, by the Department, of any ores from this district; but, judging from the assays shown to the writer by the owners, a number of the silver-lead properties are well worth developing.

Several new coal areas at widely separated localities were briefly examined, but none of them appeared to be of great importance; though more detailed work may, in some cases, prove the existence of better seams than have been so far uncovered.

Field work was carried on from the end of May until the middle of September, but an exceptionally wet and cold season, unfortunately, seriously impeded progress.

From a measured base-line a system of triangulation was begun, and connected with the system carried on in previous years in the Bulkley valley, to the south, which extended as far as the headwaters of the Morice river. With this triangulation, combined with a road traverse through the Bulkley valley and other minor surveys, nearly sufficient material is on hand for the compilation of a map extending from Hazelton, on the Skeena, to Pleasant Valley, at the junction of the Morice and Bulkley rivers. A number of fossils collected during the past two seasons have been cursorily examined by Mr. Lawrence Lambe, of the Geological Survey, the ages given to the various formations being based on his determinations.

Location and Area.

The greater part of the season was spent within a radius of 20 miles from the town of Hazelton, situated on Skeena river, at the mouth of the Bulkley, and the chief distributing point for all the country drained by these rivers, as well as for the placer camps on the Finlay, Omineca, and Manson waters to the east.

At present Hazelton is reached by river steamers from Prince Rupert (about 180 miles distant) during the short summer season of navigation; or by pack trail from Quesnel, on the Cariboo road, a long journey of about 350 miles. The completion of the Grand Trunk Pacific, however, will afford direct communication by rail.

Previous Work.

This district has been, for many years, on the main trail to the old placer diggings to the east, though but little attention was paid to the country immediately tributary to Hazelton. Dr. Dawson briefly reviewed the geology in his report on 'An Exploration from Port Simpson to Edmonton' (Report of Progress, 1879-80), and Mr. Wm. Fleet Robertson, Provincial Mineralogist for British Columbia, paid a hurried visit to the mineral properties of the Telkwa in 1905 (Report of Minister of Mines, British Columbia, for 1905). These reports, with the Summaries for 1906, 1907, and 1908, and the preliminary report on 'The Telkwa River and Vicinity' by the writer, represent virtually all that has been written on this country.

Summary and Conclusion.

The geological conditions obtaining in the districts traversed during the past season, vary little from those described in previous summary reports, with this exception, that the rocks there attributed to the Porphyrite group,[1] represented on the Telkwa by a great thickness of volcanics (tuffs, agglomerates, andesitic flows, etc.), are, apparently, gradually replaced to the north by sediments largely of volcanic origin, but towards the top consisting of shales and sandstone.

The occurrence of mineral-bearing lodes appears to depend upon the presence of eruptive areas later than the Hazelton group. This is exemplified on Twentymile, Ninemile, and Sixmile mountains, where three comparatively small granitic areas have numerous mineral claims located around their peripheries. It seems, therefore, important that prospectors should examine closely the neighbourhood of any such intrusive areas.

The coal-bearing beds overlie those of the Hazelton group, and are readily distinguishable from them in the Telkwa River region, but to the north, in the vicinity of Hazelton, the difference is not so marked. The coal beds, wherever seen, lie in comparatively shallow synclines; the overlying rocks being so soft that they have offered little resistance to erosion. Coal has been found in many places between the Morice and Kispiox rivers, in most cases only in small isolated areas of which few are of commercial value. In some cases, however, the acreage is comparatively large and the quality of the coal excellent.

Up to the present, coal prospecting has been carried on in a very crude, unsystematic manner, little or no attempt having been made to define the limits of the various areas. Before the boundaries of these areas are finally located, which will probably necessitate some method of boring, little idea of the true value of the properties can be deduced. In a number of cases the seams have already been proved to be of good workable thickness and of excellent quality.

TOPOGRAPHY.

The district is, generally speaking, mountainous, but is intersected by a number of comparatively wide valleys; those of the Skeena, Bulkley, and Kispiox rivers, and Babine lake being the most important. They contain a large area of fertile land which has attracted many settlers during the past few years.

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[1] The name, Porphyrite group, a descriptive term objectionable on this account and, as regards the district now being described, a misnomer, is replaced by a new name, the Hazelton group.

The mountains in many places are high and rugged, reaching elevations of over 8,000 feet, but are usually found in irregular, isolated blocks rather than in definite ranges, the mountain masses being separated from one another by low, wide passes. The most noticeable examples of this structure are the Rochérs Deboulés, near Hazelton, and the Hudson Bay mountains to the south.

The larger valleys all show more or less well-defined terraces, and in many places the streams have cut through the ancient valley floors, forming secondary, narrow, cañon-like channels. This is well shown at Moriceton cañon, on the Bulkley, and the Kitseguecla cañon, on the Skeena, as well as at many other places.

GENERAL GEOLOGY.

By far the largest area in the district is underlain by rocks of the Hazelton group; or, as named by Dr. Dawson in his report on the Français Lake district to the south, and his exploration up the Skeena river; the Porphyrite group. This latter name was used by the writer in previous summary reports, as it appeared appropriate to the rocks of the Telkwa country, then under investigation. In the neighbourhood of Hazelton, however, it would appear that this designation might prove misleading, as there seems to have been from south to north a gradual transition from rocks of purely volcanic origin (chiefly porphyrites) to aqueous deposits such as those on Sixmile and Ninemile mountains, near Hazelton.

These rocks are overlain conformably by the coal-bearing beds which represent the youngest sedimentaries definitely known in the district; although it is very possible that some small Tertiary outliers may have been overlooked.

From a metalliferous miner's point of view, probably the most important geological factor is a series of granitic areas, younger than either the Hazelton group or the coal-bearing beds, and around which most of the mineral locations have been made.

TABLE OF FORMATIONS.

Age.	Name.
1. Tertiary ?	Bulkley Eruptives.
2. Lower Cretaceous	Skeena Series.
3. Jurassic	Hazelton Group.

Description of Formations.

The terms 'Bulkley Eruptives' and 'Skeena Series' are here used for the first time, but in reading this in connexion with previous reports no difficulty should be experienced in identifying them, under this nomenclature, with the rocks described heretofore.

Bulkley Eruptives.—The eruptives met with during the past season are very similar to those noted in previous years on the Telkwa river and Hudson Bay mountains. A number of small areas were seen, notably on Twentymile, Ninemile, and Sixmile mountains, in no case of great size (probably none of them exceeding 1½ miles in greatest diameter), but, on account of their relationship to the ore bodies, of much importance.

These rocks have not yet been microscopically examined, but, generally, are granitic in appearance, often coarse grained, with much biotite and quartz developed, and vary greatly in colour and texture. Towards the contact they become in places porphyritic, and have caught up and apparently assimilated, to a greater or less extent, masses of the surrounding rocks, forming a zone in which it is difficult to define their boundaries. In colour they range from a light pink to a medium grey.

Practically all the known ore bodies are closely associated with these eruptive areas, the ore occurring either along the contacts or in, and alongside of dikes and fissures within a short distance of them. Nothing definite is yet known as to the age of these rocks. They are provisionally placed in the Tertiary, but may be older.

Skeena Series.—The Skeena coal-bearing series is met with in many localities, but as a rule in small patches. These appear to be the remnants of one or more great coal fields which, owing to the soft nature of the beds, have been unable, except in protected places, to resist erosion. The lower members of this series consist chiefly of conglomerates and coarse sandstone overlain by thin-bedded, shaly sandstones, nodular shales, and coal seams. Above the coal. shales are the predominant rocks, though in some places soft sandstones are found. There does not appear to be more than a few hundred feet of strata over the workable seams, except, perhaps, on the Morice river, where the denudation, to all appearances, was not so marked.

Small patches of these rocks are to be found at many places from the Kispiox to the Morice rivers, folded in with the underlying Hazelton group.

From a few fossil plants, collected during the past three seasons, it appears that these beds may be referred to the lower Cretaceous, about the horizon of the Kootanie series.

Hazelton (Porphyrite) Group.—The Porphyrite group consists, for the most part, of a great series of volcanics typically exposed on the Telkwa river and Hudson Bay mountains, and which have been described in previous reports. Northward and eastward from these localities, however, there appears to be a gradual passage from beds of purely volcanic origin to others of aqueous deposition but composed largely of volcanic material. At the top of the series fossiliferous sandstones and shales appear. The mountains to the north of Hazelton on both sides of the Skeena river are composed of rocks almost entirely of sedimentary origin, while the Rochérs Deboulés range, between the Bulkley and Kitseguecla rivers, is largely built up of volcanic flows, breccias, tuffs, etc.

From the fossil evidence so far obtained, the upper beds of this group (sandstones and shales) appear to be equivalent to the Fernie shales of East Kootenay and Alberta, and the 'Lower shales' of the Queen Charlotte Islands series, now supposed to be Jurassic. No fossils have been secured from the lower part of the Hazelton group.

ECONOMIC GEOLOGY.

The intrusive granitic masses of the Bulkley eruptives have everywhere played an important part in the deposition of ore bodies; all of the chief mineral claims visited being situated either near their contacts or in, or alongside of dikes from them.

The eruptives have also affected the coal areas to a large extent; not only have the coal seams in places been cut by dikes, but the coal usually becomes more anthracitic in character as the intrusive granitic masses are approached.

Groups of Deposits.

COPPER AND SILVER.

The copper ores of the Telkwa and the silver-lead veins of the Hudson Bay mountains have been briefly described in the last two Summary Reports, and no new information was obtained in regard to them during the past season.

SILVER-LEAD.

The most important recent development has been the opening up of a number of silver-lead veins on Sixmile, Ninemile, and Twentymile mountains, north of Hazelton. At all these points the ore is of the same general character, the principal minerals being galena, arsenopyrite, stibnite, and zinc blende in a quartzose gangue. The veins

are not large, but are reported to be rich in silver. Only two assays have been made by this department, both of which show good silver contents. The gold values are small.

The veins occur as a rule either in fissures in a hardened sandstone near its contact with intrusive granitic areas, or in sheared zones in the granitic mass itself. In one case (the 'Era, 'on Sixmile mountain) the ore appears to follow the line of contact between the two formations.

Up to the end of the season nothing but surface prospecting has been attempted, and, except from the 'Lead King,' no ore has been shipped. From this property about five tons of galena were taken from an open-cut, sacked and packed on horses down to Hazelton for shipment to a smelter.

Description of Prospects.

Jack of Hearts and Jack of Spades.—Jack of Hearts and Jack of Spades claims are situated on Twentymile mountain. The ore appears to follow a bedding plane in altered sedimentary rocks, the foot-wall consisting of rusty, decomposed argillite, and the hanging-wall of hard silicified sandstone. The strike is about N 30° E and the dip 50° northwest. The little work done—consisting of a few small open-cuts—is situated in the altered sedimentaries, but the claims extend into a comparatively large area of intrusive granitic rock to the west. The ore is much decomposed, and consists of about 18 inches of zinc blende, seamed with thin bands of greyish-white, magnesian ankerite, and a little galena, with a small quantity of rusty quartz gangue.

Silver Cup.—This claim, included in a group of four owned by Messrs. Harris and Trainer, is located on Ninemile mountain, about 6 miles north of Hazelton. The ore occurs in a highly altered sandstone, in places approaching a quartzite, a short distance to the east of an important granitic area. Strike of vein is about N 30° E, with a dip of 73° southeast, while the country rock strikes S 55° W, and dips 15° northwest. Two open-cuts have been made on this claim, the lower of which shows both walls well defined and the vein 1·2 feet in width. The vein matter consists, at this point, of nearly solid galena, with a little stibnite, arsenopyrite, blende, and white quartz.

The following assays of this ore were shown the writer by Mr. Harris:—

	No. 1.	No. 2.	No. 3.
Gold..	trace.	trace.	trace.
Silver..	181·0 ozs.	268·2 ozs.	187·4 ozs.
Lead..	70·0 %	50·0 %	58·4 %

(All by the Canadian Consolidated Mining and Smelting Company.)

The second cut lies about 200 feet farther south. Here the vein opens out, being about 2·5 feet in width; but the ore is not so solid, less galena being present; while there is more stibnite, and much more quartz.

Silver Dollar.—The Silver Dollar claim belongs to the same group as the last mentioned, and is opened by a cut about 2,000 feet south of those on the 'Silver Cup.' Similar conditions are found here, and it is possible that this is the same vein. The vein, where cut, is 3·2 feet wide, the ore consisting of milk-white quartz carrying disseminated crystals of arsenopyrite, a little stibnite, iron pyrites, and a very little magnetite.

Hazelton.—The Hazelton adjoins the Silver Dollar to the west, the geological conditions being similar. Near the eastern end of this claim a small vein has been cut which has a strike nearly at right angles to that on the Silver Dollar, viz.,

NOTE.—All bearings given are referable to the true meridian. Magnetic variation is about 30 degrees east.

S 70° E, with a nearly vertical dip. This vein is only 0·7 of a foot wide, with well defined walls; the country rock being a hard, altered sandstone. The ore consists of finely crystalline arsenopyrite associated with a little white quartz.

At the western end of the claim several open-cuts show a little ore. The rock here is much shattered and altered, being very near the granite contact. One small vein, 6 inches wide, was stripped, and here consists of white quartz with crystalline galena and a little brown zinc blende.

Sunrise.—Sunrise claim is one of a group of four owned by Messrs. Harris and Rosenthal, and is situated about one-half mile northeast of the 'Silver Cup.' The ore occurs in the granite, not far from its contact with the sandstones, and appears to follow a line of crushing and faulting. The vein strikes S 75° W, and dips to the south at an angle of 60° where opened by a cut. The foot-wall is well defined, smooth and slickensided, while the hanging wall is not so clearly shown and is much shattered and decomposed. In the cut the vein is 2·7 feet in width, and shows 0·8 of a foot of solid galena about the middle of the vein, the remainder consisting of quartz with disseminated galena and a little stibnite.

The following analyses from samples of the solid galena were handed to the writer by Mr. Rosenthal:—

	Gold.	Silver.	Lead.
1..	trace	116·6 ozs.	55·2 per cent.
2..	"	125·0 "	75·5 "
3..	"	115·0 "	65·2 "
4..	"	120·0 "	75·0 "
5..	"	115·0 "	65·0 "

(All by the Canadian Consolidated Mining and Smelting Company.)

About 300 feet to the west of this opening another vein has been stripped on this claim. The vein is 12 inches wide, and strikes east and west, dipping south 15°. The ore is an association of white quartz with a little white dolomite, carrying very small amounts of galena and zinc blende.

Lead King.—The Lead King mineral claim lies about one-quarter of a mile to the west of the Sunrise, and is situated in the granite near its contact with the sedimentaries. The granite here is much shattered, numerous small slickensided fault planes at all angles being in evidence; the ore apparently occurring along a line of weakness. The vein has been stripped at a point where it has been much disturbed, and it is doubtful whether the dip seen here can be considered as normal. In the cut the strike is east and west, and the dip S 22°. The width of the vein is 3·1 feet, the whole being heavily mineralized: the ore being an association of finely crystalline galena with some zinc blende, together with a small amount of weathered siliceous gangue.

As before stated, a shipment of about five tons has been made from this property for a smelter test, but as yet no returns are available.

Era Group.—The Era group of four claims is situated on Sixmile mountain, between Sixmile and Fourmile creeks, about 5 miles from Hazelton. A number of open-cuts have been made on the property, all of which show some ore. There appears to be a number of irregular veins developed along small fault planes and crushed zones in a small granitic area (this eruptive mass being distinct from that on Ninemile mountain). In one case, however, on the 'Era' claim, the ore appears to have developed along the contact of the granite and the sedimentaries; the hanging-wall consisting of highly metamorphosed sandstone and the foot-wall of granite. At one point on this contact an open-cut has been made, exposing 3·9 feet of ore, the strike being about northeast and dip 70° southeast. On the foot-wall the ore consists of white quartz with small quantities of disseminated galena, while on the hanging-

wall the mineralization is much heavier, there being from 18 inches to 2 feet of almost solid sulphides of antimony, lead, arsenic, silver, and copper, with a little white quartz gangue. It contains, also, a little free sulphur.

Two assays of this ore by the Mines Branch, are here given:—

	Gold.	Silver.	Lead.	Copper.
No. 1	0·08 ozs.	358·17 ozs.	7·81 %	0·75 %
No. 2	0·02 ozs.	46·16 ozs.	6·90 %	0·26 %

The samples also showed antimony and arsenic in considerable quantities.

COAL.

Shegunia River Area.—The Shegunia river (Salmon river) coal area is situated on the east bank of the Skeena river, 2 or 3 miles above the mouth of the Shegunia. The limits of this basin were not traced out, but sufficient work was done to prove it to be of considerable extent. The strata, however, where exposed along the Skeena banks, are so highly flexed and faulted that it seems improbable that mining can ever be successfully undertaken unless further prospecting proves the seams to be in a less disturbed condition in other parts of the basin.

This property has been more or less prospected for some years, but never systematically. At present all that can be seen is an old shaft about 25 feet deep (now partly caved), a few open-cuts, and a cross-cut tunnel 35 feet in length which has not yet reached the coal.

At least three seams were noted, their relative position being somewhat doubtful on account of the disturbed nature of the strata. An approximate section of the coal beds, where the seams are stripped, is here given:—

	Grey shales	
1.	Coal	2·0 feet.
	Shales and sandstone	75·0 "
	Black carbonaceous shale	3·0 "
2.	Coal	2·1 "
	Sandstone and shale	about 50·0 "
3.	Coal	5·1 "
	Grey and carbonaceous shale	

In all three seams the coal is very severely crushed, and in the case of seams 2 and 3 at least, is high in ash. Analyses of the two lower seams are as follows:—

	Moisture.	Vol. Comb.	Fixed Carbon.	Ash.
No. 2 seam	1·42	18·76	58·20	21·62
No. 3 seam	1·18	20·63	57·27	20·92

No. 2 seam, non-coking.
No. 3 seam, cokes.

Babine Lake Coal.—A hurried trip was taken to a reported new coal area on Babine lake. Four claims had been staked on the Tuchee river about 17 miles above its mouth. This stream flows into Babine lake from the west about 50 miles above the outlet, and drains most of the eastern slope of the Babine range.

On arrival at the claims, it was found that very little work had been done, and most of that had been obliterated by a small landslide. Without time and tools it was impossible to determine the extent of the area or the size and value of the coal seams. All that can be said in reference to these claims is, that the Coal Measures are present, and that one small seam (about 2 feet thick) of impure coal was seen. It is possible that other and better seams may ultimately be found underlying a considerable area, but much prospecting is necessary before the value of this property is determined.

The following analyses is from a sample of the above-mentioned 2 ft. seam:—

Moisture	2·55
Vol. comb	17·28
Fixed carbon	52·20
Ash	27·97

Does not coke.

Since this visit, the finding of seams of coal of fair width is reported.

Morice River Coal.—A new coal area was discovered late last summer on the Morice river, below those described in the Summary Reports for 1907 and 1908, and about 30 miles above the junction of the Morice and Bulkley rivers. As the season was rapidly drawing to a close, little time was available for examination of this basin. From a cursory visit, it would appear that there is quite an extensive area here underlain by the coal-bearing beds, but only one seam has so far been stripped, showing the following section:—

Grey shale		feet.
Clean coal	0·45	"
Shale	0·05	"
Clean coal	0·40	"
Shaly coal	1·20	"
Hard, blocky coal	1·40	"
Grey clay shale	2·00	"
Coal	0·80	"

Of the following analyses, No. 1 is from the lower bench (0·8 feet) and No. 2 from the cleaner portions of the upper part of the seam:—

	Moisture.	Vol. Comb.	Fixed Carbon.	Ash.
No. 1	2·65	23·93	48·95	24·47
No. 2	2·05	29·43	57·38	11·14

No. 1 is non-coking, and No. 2 cokes well.

It is to be hoped that future prospecting will bring to light some workable seams similar in character to No. 2, as up to the present time, as far as the writer knows, no satisfactory coking coal has yet been found in the Skeena River country.

Manson Creek Hydraulic Mining.

Although referring to a property outside of the district covered this year by the writer, the following notes furnished by Mr. H. Beach, of the Kildare Mining Company, may be of interest.

The Omineca placer diggings have been worked for many years, chiefly by individual miners, the output of late years being insignificant.

The 43rd Mining Company, and their successor the Kildare Mining Company, have for thirteen years been prospecting their territory on Slate creek, with the object of starting hydraulic mining on a large scale. The difficulties of mining in this district are very great, everything having to be packed on horseback over a poor trail for about 200 miles from Hazelton. Seven or 8 miles of flume and ditch have been built, and a small prospecting plant installed. During last season bed-rock was reached in an old channel, and during July and the beginning of August about $10,000 in coarse gold recovered. This was accomplished with a force of 20 men and an inadequate plant. Work then stopped until proper machinery was installed, enabling the property to be economically managed.

Mr. Beach reports that there are from 25 to 30 feet of gravel above bed-rock, the whole of which he considers will average about $3 a yard.

Besides coarse gold, with many nuggets, the following metals and minerals were recovered in the sluice boxes: native silver, native copper, platinum, arquerite (native silver amalgam), iridium, and much galena.

TEXADA ISLAND AND MORESBY ISLAND, B.C.

(R. G. McConnell.)

The work of the season consisted in completing the geological mapping and examination of the mines and prospects on Texada island, and in a hurried visit of seventeen days to some of the principal mineral districts on Moresby island, in the Queen Charlotte group. I was assisted in the Texada Island work by Mr. A. O. Hayes.

TEXADA ISLAND.

The rocks and the principal mines and prospects occurring in the northern part of Texada island were examined in 1908, and briefly described in the Summary Report of the Geological Survey for that year. During the present season the work in the northern part of the island was completed, and the examination extended to the southern portion.

Topography.

The southern part of Texada island consists of a steep-sided rocky ridge rising directly from the sea, surmounted by occasional peaks, some of which reach an elevation of nearly 3,000 feet. North and west of Pocohontas mountain the general elevation decreases rapidly, and the surface, while still broken by occasional rounded eminences, such as Comet and Surprise mountains, becomes more even and in places assumes a plain-like character.

The island nowhere exceeds 6 miles in width, and the streams draining it are necessarily short and small. Many of them are intermittent, and only a few of the larger ones flow steadily throughout the year. Lakes, varying in size up to half a mile in length, occur at a number of points, mainly in the lowlands at the northern end of the island, but also occasionally in depressions on the slopes and near the summits of the higher elevations.

The greater part of the island is still well wooded, although a portion of the original luxuriant forest has been destroyed by forest fires or cut for commercial purposes. The principal tree is the useful Douglas fir. Other trees found with it include species of hemlock, pine, spruce, and cedar. The broad-leafed varieties are represented by the maple, arbutus, and alder.

Summary of Geology.

The rock formations of Texada island are not numerous, are mostly of igneous origin, and range in age from upper Palæozoic to middle Cretaceous. They have been classified as follows:—

1. Pleistocene.. .. .. Boulder clays, stratified sands and gravels.
2. Cretaceous.. .. .. Soft sandstones, sands, clays, and shales.
3 Lower Cretaceous or Upper Jurassic.. .. .. Diorites and diorite porphyrites, dikes and small stocks.
4. Upper Jurassic ?.. .. .. Quartz diorites; referred to period of Coast Range batholith.
5. Triassic ?.. .. .. Porphyrites, Texada formation, Texada group of Leroy (in part).
6. Upper Palæozoic.. .. .. Limestones, Marble Bay formation.
7. Upper Palæozoic.. .. .. Schists, tuffs, agglomerates, marbles, etc. Anderson Bay formation, Texada group of Leroy (in part).

Anderson Bay Formation.—The rocks of this group occupy a small area at the southern end of the island, and a narrow band extends northward for some distance along the east coast. They consist mainly of dark, light-greyish, and greenish schists and shales probably mostly of tufaceous origin, interbanded with agglomerates and occasional narrow lenses of crystalline limestone. They were nowhere found in contact with the limestones of the Marble Bay formation, and have been placed below them principally on acccount of their greater alteration.

Marble Bay Formation.—The Marble Bay formation occurs mostly in the northern end of the island, and was described in the Summary Report for 1908. It consists altogether of limestone usually whitened and crystallized near contacts with igneous masses. It originally extended southward over the greater portion of the island, but has been largely destroyed by the various intrusions of igneous rocks which followed its deposition.

Texada Formation.—The rocks referred to the Texada formation are widely distributed over the island from Crescent bay southward to Mount Dick, and form all the higher peaks and ridges. They consist altogether of porphyrites showing considerable diversity both in appearance and in the proportions of the constituent minerals. Normally the porphyrites are brownish weathering, medium to fine-grained, greenish or greyish rocks, made up of a ground-mass of plagioclase and varying quantities of augite, hornblende, and chlorite, sprinkled more or less plentifully with plagioclase phenocrysts which on the surface usually present a faded appearance. The ferromagnesian minerals seldom occur conspicuously as phenocrysts. The normal type passes in places into a fine-grained, compact, greenish rock, and more frequently into a medium-grained granular rock showing macroscopically only traces of the ordinary porphyritic texture.

Amygdular rounded and elongated cavities filled with quartz, calcite, and epidote, and lined with a dark chloritic mineral, occur sparingly in certain areas.

The porphyrites in many sections have a conspicuous nodular structure, and in places closely resemble, and were at first mistaken for, a volcanic agglomerate. The nodules are usually finer grained and harder than the enclosing matrix, and project on weathered surfaces. In shape, they vary from spheroids usually from 6 inches to 1 foot in diameter, to elongated, flattened, nodular masses 10 to 15 feet or more in length. The nodular porphyrite occurs in small and large irregular areas, separated by the normal uniform variety.

The nodules are similar in mineral composition to the enclosing matrix and the massive variety, and they probably represent the first centres of crystallization in the cooling magma.

Quartz Diorites.—The rocks referred to the quartz diorites occur mostly in small areas fringing the northeast coast along the central portion of the island. One area also occurs on the west coast at the Iron range, and one inland. The quartz diorites are mostly greyish granular rocks resembling granites, and were classed as granites in previous reports. The present classification is due to a study of a number of thin sections by Dr. Young, who described them as consisting essentially of plagioclase with varying and much smaller amounts of quartz and biotite accompanied by hornblende, or pyroxene, or both. A small quantity of orthoclase is also usually present, and magnetite is a constant accessory.

The quartz diorites are regarded as an extension westward across the Malaspina straits of the Coast Range batholith rocks of the neighbouring mainland.

Diorites and Diorite Porphyrites.—The rocks of this group occur in small stocks and in dikes distributed mostly over the northern part of the island. The stocks intrude the porphyrites and the limestones of the Marble Bay formation, but have not been found in contact with the quartz diorites. Some of the diorite stocks are younger

than the typical quartz diorites, as inclusions of the latter were found in one area; and dikes which occur as apophyses from the diorite areas are indistinguishable from dikes cutting the quartz diorites. The two groups are, however, closely related, and some of the stocks cannot be referred with certainty to either.

The diorite and quartz diorite stocks are important economically, as most of the valuable mineral deposits of the island occur either at or near their boundaries.

Cretaceous.—Cretaceous rocks occur on the west coast of Texada island in small isolated areas extending from Gillies bay southward to Cook bay. The areas were probably connected originally, and have been separated by erosion. The rocks consist of clays, shales, soft sandstones, and conglomerates. No coal or lignite beds were seen, and it is unlikely that any exist, as the series is well exposed in the valleys of the streams cutting the areas.

The porphyrite floor on which the Cretaceous beds rest is more or less decomposed, to a depth, in one instance, of 100 feet or more. The decomposed material occurs both in an unstratified condition filled with cores of the original rock, and sorted by water into beds of soft red clay and loose reddish conglomerate. The red clay beds are reported to contain about 13 per cent of iron, and may be of some economic value.

The Cretaceoeus beds show only slight disturbance, if any, are not cut by dikes or other intrusive bodies, and are not mineralized. They were evidently deposited after vulcanism on the island had ceased.

Glacial Deposits.—Texada island was probably entirely covered with ice during the Glacial Period, and deposits of this age consisting of boulder clays, stratified sands, silts, clays, and gravels on the lower lands, and scattered erratics on the higher, are present everywhere. The boulder clays and associated beds are not evenly distributed, and occur mostly in irregular areas extending inland from the west coast. Over the greater part of the island the covering is thin, and ridges and hummocks of the older rocks project through it.

Mines and Minerals.

The principal mineral deposits of Texada are situated in the northern part of the island, and were briefly described in the Summary Report for 1908. In the vicinity of Van Anda, work was steadily prosecuted during the season on the Marble Bay, Cornell, and Little Billy mines; and in addition the Copper Queen was unwatered and some exploratory work done.

The principal work carried out on the Marble Bay mine during the past year consisted in exploring the new ore body first encountered in the 10th level at a depth of 863 feet. It has proved to be an exceedingly important one. At a depth of 960 feet, the present working level, this ore body, shaped like a flattened $\vee$ with the apex to the west, has a proved length of 180 feet and an average width of about 15 feet. The grade of the ore is somewhat higher than usual, the first-class ores carrying about 11 per cent copper, $10 in gold, and from 5 to 6 ounces of silver per ton. Among the more important changes noted in depth, in this mine, are the increasing proportion of bornite compared to chalcopyrite, the better definition of the ore body, the copper sulphides around the greater part of the periphery ceasing abruptly against a lime wall in place of diminishing gradually through a bordering zone of secondary mnerals, and the introduction between the 10th and 11th levels of native silver in small, thin leaves, scales, and grains. The silver occurs mostly with the bornite, occasionally in the calcite gangue, and never, so far as noted, with the chalcopyrite. The addition of native silver to the ordinary minerals of the ores is marked by an increase in the silver tenor from 3 or 4 ounces to 5 or 6 ounces per ton.

At the Cornell mine the extension of the 360 ft. level has resulted in the discovery of several fair sized ore bodies, all, with one exception, carrying high grade ore. The shipments from these average at present about 1,000 tons per month. Development work is now in progress to ascertain if the ore bodies extend down to the 460 ft. level. No ore has so far been found in this level. The ore bodies of the Cornell, while more numerous, are smaller and more uncertain than those of the Marble Bay mine.

Development work on the Little Billy during the season consisted in running a drift from the old workings to undercut a surface showing in the limestone. An ore body enclosed in limestone was encountered, the full dimensions of which have not yet been determined, although it has been proved to contain a considerable tonnage of good ore.

Some development work was also done on the promising Loyal Lease claims, near Blubber bay, but no ore bodies of value were found. The important iron range on the west coast briefly described in last year's Summary was idle during the season.

South of Raven bay a mining enterprise of some magnitude has been commenced, viz., to drive a tunnel, starting near sea-level on the coast, inland under Comet mountain. The tunnel as projected will have a length of 3,000 feet or more, and—except near the mouth where it skirts a quartz-diorite-porphyrite contact—will pierce porphyrites holding occasional small inclusions of lime all the way. A number of small and medium sized magnetite lenses usually associated with lime inclusions, and some quartz veins, outcrop on Comet mountain and in its vicinity. The development work on these consists of a few open-cuts, and shafts sunk to varying depths, up to 70 feet. The magnetite lenses usually contain chalcopyrite, but no large body of shipping ore has so far been uncovered, and the purpose of the tunnel seems to be largely exploratory.

The southern part of Texada island is not mineralized to the same extent as the northern portion. Most of the important mineral deposits of the island occur in connexion with the limestone of the Marble Bay formation, and this stops, going south, a short distance south of Davies bay. The rocks south of this point consist of porphyrites cut by a few quartz-diorite stocks, mostly distributed along the east coast, and of the schists, tuffs, etc., of the Anderson Bay formation. Small lenses of crystalline limestone occur in the latter, but these, unlike the Marble Bay limestone, which is bordered everywhere by intrusive contacts with various igneous masses, are considered to be contemporaneous with the enclosing beds and form part of a regular series.

A few quartz veins, none of which, if a famous lost mine of fabulous richness supposed to exist in the vicinity of Anderson bay is excepted, are noteworthy for size or richness, constitute the discoveries up to the present. The veins carry, in places, chalcopyrite and more rarely bornite, and some good gold assays are reported. None of the veins have been mined and very little development work has been done on them.

MORESBY ISLAND.

Moresby island was visited in August. The trip occupied nearly a month, although only seventeen days were spent on the island. As hotels are somewhat scarce, my thanks are due to Mr. Ikeda, Mr. Parsons, and Mr. Morgan for accommodation and other courtesies, and to Mr. Sandilands, Mining Recorder, Mr. Nestelle, and others for information and assistance.

General Description.

The Queen Charlotte islands, of which Moresby island forms the central member, are situated in the Pacific ocean, about 450 miles northwest of Vancouver. They are separated from the islands fringing the mainland by Hecate strait, an open body of

water about 100 miles in width. A regular steamship service with Vancouver is now maintained, and one with Prince Rupert, which is situated almost directly east of the north end of Graham island, will shortly be established.

The principal resources of the Queen Charlotte islands consist of extensive fisheries, a luxuriant forest covering most of the islands, important coal seams on Graham island, and a large mineralized area on Moresby and adjacent islands, the possibilities of which are not yet fully known. Moresby and the southern islands are not well adapted for agriculture on a large scale on account of their mountainous character and excessively humid climate. Graham island, the largest of the group, is much flatter and drier, especially toward the eastern coast, and possesses large tracts capable of settlement.

The Queen Charlotte islands have been neglected in the past, and the development of their varied resources has been slow and spasmodic. Attention has been drawn to them recently, owing to their proximity to Prince Rupert, the projected terminus of a great transcontinental road, and more rapid development is now expected. With the completion of the Grand Trunk Pacific the islands will be within easy reach of an important centre.

Moresby island, a portion of which was hastily examined during the past season, has a length of 110 miles and a width in the northern part of about 25 miles. Southward, the average width decreases to about 5 miles. The coast line on the east is extremely irregular, and is interrupted by numerous bays and branching inlets, some of which cut nearly across the island. The east coast is also fringed by a multitude of islands, ranging in size from mere dots up to areas 8 or 10 miles across. The west coast has never been properly surveyed. It is more regular than the east coast, is free from islands for long distances, and harbourage is obtainable only at a few points.

The interior of Moresby island, from the southern end, north to Tasoo harbour, the portion visited, is hilly and mountainous throughout. At the southern end the mountains rise steeply from the water's edge to an elevation of from 1,000 to 2,000 feet and are wooded to their summits. Northward they increase in height, and, in the vicinity of Tasoo harbour and for some distance north and south, the main range is formed of a sierra of high, rugged peaks, rising far above the timber line.

The island is forested, densely in the valleys and more sparingly on the higher mountain slopes, up to an elevation of about 2,000 feet, the timber line of the district. The Douglas fir, the principal coast tree of southern British Columbia, is absent, and its place is taken by the gigantic Sitka spruce (*Abies sitchensis*), which furnishes excellent timber. Several specimens of this tree were seen which exceeded 10 feet in diameter. Other prominent forest trees are the red cedar (*Thuya plicata*), the valuable yellow cedar (*Chamæcyparis Nookatensis*), and a hemlock (*Tsuga heterophylla*). Shrubs grow densely and render travelling, except along the timber line, exceedingly slow and laborious.

The decay of the luxuriant vegetation has produced a heavy muck covering which is kept soft by the constant rains. The muck covering, encumbered as it usually is with numerous large fallen trees, makes trail building for men difficult and trail building for horses impossible except at great expense, and at present all supplies for the interior camps are packed up on men's backs.

GEOLOGY.

A geological examination of Moresby and the other Queen Charlotte islands was made by Dr. Dawson in 1878, and his report, published by the Geological Survey in 1880, is still the principal authority on their geology.

Sedimentary Rocks.

The older formations are not represented on the portion of Moresby island visited, and the principal sedimentary rocks seen consist of whitish and dark shales and feldspathic sandstones, probably of tufaceous origin, filled in places with Triassic fossils. The tufaceous beds are thinly bedded as a rule, and often pass into and alternate with thin beds and bands of greyish limestone. They are usually disturbed and faulted and are cut in all directions by numerous dikes.

Massive greyish limestones, usually more or less crystalline, are widely distributed in small areas, mostly as inclusions in the later intrusive rocks. They were not seen wth the tufaceous beds, and their relative age is not definitely known. Fragments of limestone, ranging in size from a few feet to half a mile or more across, occur along the east coast from Carpenter bay, north to Lockeport, and were also seen at Tasoo harbour on the west coast. They are of considerable economic importance, as many of the ore bodies of the island have formed in or near them.

Intrusive Rocks.

Porphyrites.—The most widely distributed rocks in the district visited consist of medium grained, dark basic intrusives made up mostly of hornblende and a plagioclase feldspar. They are usually more or less porphyritic in texture, and are classed generally as hornblende porphyrites. The more granular varieties resemble diorites in hand specimens.

The rocks of this group occur on Collison bay, on Ikeda bay, at Jedway, and at points between Jedway and Lockeport, and on Tasoo harbour. They are massive and comparatively fresh as a rule, but in places are strongly fissured. Numerous magnetite lenses have formed in them, often near small inclusions of lime.

Diabase.—Rocks often showing a strongly marked ophitic structure, even in hand specimens, are distributed over a considerable area in the vicinity of Klunkwoi bay and Anna lake. Their relationship to the preceding group was not ascertained. They are mostly dark greyish, medium grained massive rocks, slightly porphyritic in places and occasionally amygdular. They are interesting economically, as considerable areas are sparingly impregnated with copper sulphides.

Granites.—Greyish granitic rocks, mostly granites, but probably including several types, outcrop on the Collison Bay-Huston Inlet summit and vicinity, on Apex mountain, and on portions of Tasoo harbour. They are younger than the dark intrusives, and probably represent the period of the Coast Range batholith.

Dikes.—Dark greyish dikes, mostly hornblende porphyrites, but occasionally augite porphyrites, are numerous in the vicinity of Collison bay, Ikeda bay, Jedway, and other places. They cut all the formations, both sedimentary and igneous, previously described, and are also found traversing the ore bodies. They are younger, in some instances at least, than the mineralization of the district.

DESCRIPTION OF MINES AND PROSPECTS.

Collison Bay.

Collison Bay Mining Company.—The principal work in the vicinity of Collison bay is being done at present by the Collison Bay Mining Company, Walter H. Parsons, manager. The Company owns the Kenora claim and the Office fraction, and are working the Black Prince under bond. The claims are situated about half a mile from the beach at an elevation of about 500 feet above it.

The country rock is a massive hornblende porphyrite. It holds some small limestone inclusions and is cut by numerous dikes.

The surface showings consist of seven vein-like leads, evidently following fissures or zones of fissuring. Five of these run nearly north and south and are approximately parallel, while two have a NW-SE strike. The main lead has been stripped for 150 feet and uncovered at intervals for 800 feet. Its width varies from 1 to about 5 feet, but it swells out to 12 feet at a point known as the Gordon Cut. The vein filling is mostly magnetite, but varies greatly along the strike. At the Gordon Cut it consists of chalcopyrite and pyrrhotite in a gangue of altered country rock. The sulphides are accompanied by small quantities of garnet, dark amphibole, augite, and calcite. South of the Gordon Cut, the main lead splits up into three branches, all somewhat similar in character, except that the most westerly one follows for some distance a limestone inclusion from 1 to 2 feet wide. Chalcopyrite occurs somewhat plentifully in the lead where it follows the lime, while beyond it in both directions the vein consists mostly of magnetite.

The main lead near the Gordon Cut outcrops on a steep hillside, and is opened up by a cross-cut tunnel which reaches the vein at a distance of 110 feet. From the end of the cross-cut, a tunnel has been run southward along the lead for 28 feet and northward 184 feet to a point under the Gordon Cut. An incline shaft 97 feet in length has also been sunk at the end of the south drift, and some drifting done at its foot. The development work has been planned judiciously, but the results so far have been disappointing. The ore continues down, but at the depth reached is less concentrated than on the surface and the values are stated to be lower.

At the time of my visit work on the main lead was suspended and one of the cross leads was being opened up. This lead is traceable for about 200 feet, and at one point swells out to a width of 20 feet. A cross-cut tunnel is now being driven towards it. The vein filling on the surface is principally magnetite holding considerable chalcopyrite, and is said to carry good values in gold.

Oceanic.—This claim is situated close to the beach at the head of Collison bay. The country rock here is a porphyrite holding some small limestone inclusions. There is no defined lead, and the ore consists of the altered and mineralized limestone and portions of the bordering intrusive. The valuable minerals present are chalcopyrite and small quantities of bornite. The deposit has been opened up by two shallow pits 30 feet apart, and some surface stripping. Twelve tons of ore, said to have yielded 3 per cent copper and small values in gold, have been shipped.

Meal Ticket.—The showing on the Meal Ticket is situated near the foot of the ridge bordering Collison bay on the northwest, at an elevation of 225 feet above sea-level, and consists of a tabular lens of magnetite apparently lying in a nearly horizontal position in porphyrites. The lens has a thickness of from 3 to 8 feet and is exposed on the hillside for a distance of about 200 feet. The principal minerals associated with the magnetite are chalcopyrite, pyrrhotite, epidote, garnet, and quartz. The chalcopyrite is somewhat sparingly distributed through the magnetite, except along a stretch about 30 feet in length near the north end, where it is fairly abundant. A small, vein-like lead south of the magnetite lens contains some good ore, principally chalcopyrite.

The development work consists of two tunnels, one 35 feet in length situated immediately below the south end of the ore body, and the other 80 feet in length lower down the slope. Neither of the tunnels affords much information.

Princess Group.—This group is situated at an elevation of 1,500 feet above sea-level on the crest of a ridge overlooking Carpenter bay. The rocks consist of a wide granite dike, cutting basic igneous rocks, too altered for recognition, and occasional outcrops of crystalline limestone. A lens of magnetite about 45 feet in length and 18 feet in width, holding considerable chalcopyrite at one point, outcrops a short distance below the summit of the ridge at the contact of the two intrusives. A strong lead

showing decomposed magnetite in places also crosses the summit, and is exposed by small open-cuts. The principal development work consists of a tunnel driven through the magnetite lens and for some distance into the country rock beyond.

Iscroyd Group.—These claims are situated about 3 miles from Collison bay across the summit to Huston inlet, at an elevation of 600 feet above sea-level. The rocks here are whitish altered tuffs cut by a granite stock. Both rocks are mineralized along their contact over a considerable area with chalcopyrite and pyrrhotite. The open-cuts which constitute the present development work show two small areas, holding considerable chalcopyrite, both of which occur in altered granite. In the tuffs, pyrrhotite is the principal mineral.

Ikeda Bay.

Ikeda bay is situated a short distance northwest of Collison bay, and is connected with it by a foot trail. Most of the claims in the vicinity are owned by Awaya, Ikeda & Co., a Japanese company. This Company controls 47 claims and, under the management of Mr. Ikeda, has done a large amount of work, principally on the Lily group.

LILY MINE.

The country rock in the vicinity of the Lily mine and Ikeda bay is a dark, massive, medium grained hornblende porphyrite, resembling a diorite in hand specimens. It is fissured in places, holds occasional inclusions of lime, one of which crosses the Lily lead, and is cut by a number of porphyrite dikes which are later than the mineralization. It is probably an extension of the intrusive area exposed at Collison bay, but is less distinctly porphyritic.

Development.—The Lily mine is situated about a mile from the beach. The lead outcrops on a slope rising at an angle of 20°. The main workings consist of a tunnel 800 feet in length and two short tunnels higher up the slope, all following a long, fissured zone. A fourth tunnel at an elevation of 300 feet above the main one and starting 250 feet beyond it, has also been commenced. It follows a shear zone, considered by the management to be a continuation of the one followed in the lower levels. In the upper level a small lime fragment is enclosed in the diorite.

Ore Bodies and Ores.—In the lower level two ore bodies were encountered, the first 25 feet and the second 175 feet in length. The latter has been stoped to the surface. Its width varies from 2 to 10 feet and averages about 4 feet. The ores consist of chalcopyrite, carrying some values in gold and silver, associated with pyrrhotite, pyrite, and rarely, magnetite. The gangue is principally the more or less altered country rock usually holding small quantities of various secondary minerals, principally epidote, garnet, hornblende, calcite, and quartz. Shipments of 2,342 tons of ore have been made from this vein, averaging about 10·4 per cent of copper, 4 ounces silver and 0·238 of an ounce gold per ton. No ore has been taken out so far and no development work done below the level of the tunnel.

The shear zone striking nearly south and dipping steeply to the east has been explored for some distance beyond the ore body. The fissured porphyrite is altered and mineralized in places, but no shipping ore was found.

A drift to the west from the lower tunnel about 550 feet from its mouth led to an important discovery. The drift followed a branch fissure carrying some scattered ore, and at a distance of about 100 feet entered a large ore body, the full extent of which is not yet determined. The present chamber has a length of over 70 feet and a width of 51 feet. The porphyrite here is cut by two dikes and is fissured in various directions, but not shattered. The ore is low grade, and consists of grains, bunches, and small lenticles of chalcopyrite and pyrrhotite scattered through the country rock.

Small quantities of pyrite and magnetite are also present. The porphyrite is somewhat altered, and various secondary minerals, including quartz, calcite, epidote, garnet, and hornblende are sparingly distributed through it. The shipments yielded 2·99 per cent copper, 1·21 ounces silver and 0·076 of an ounce gold per ton. Shipments up to the present aggregate about 6,000 tons.

Equipment.—The equipment at the mine includes an 80 horse-power boiler, an Ingersoll-Rand compressor running three drills, and a donkey engine used for hauling up the empty cars. A wharf with capacious ore bunkers has been built on Ikeda bay, and is connected with the mine by a tramway 6,200 feet in length. The buildings include an excellent boiler house, machine and blacksmith shops, and several cottages.

With the exception of the Lily group, the numerous claims of the Awaya-Ikeda Company are still practically undeveloped. Some stripping and surface work has been done on the Crysanthemum group, and several magnetite lenses, one about 100 feet in length, have been exposed. The magnetite, as usual, carries some copper and iron sulphides. On the Wistaria claim a small calcite vein carrying free gold has been explored for a short distance. Numerous exposures of mineral, mostly magnetite, are reported on other claims, but were not examined.

Jedway.

Mining at Jedway, on Harriet harbour, was at a standstill at the time of my visit, principally on account of litigation over various properties. Numerous discoveries have been made in the neighbourhood, but with the exception of a tunnel on the Copper Queen, little development work has been done.

Geology.—The rocks seen include tuffs, argillites, and interbedded limestones of Triassic age. These are well exposed along the coast, but are replaced, going inland, by a dark slightly porphyritic rock similar to that at Ikeda bay. The latter is intruded at various points by greyish granite. Massive limestones also occur on Copper island, and at various other points, as inclusions in the porphyrite and granite.

Copper Queen.—This claim is situated on the southwest side of Harriet harbour at an elevation of 750 feet above sea-level. A tram-line to the beach, 4,800 feet in length, has been cut out. The mineral exposures consist of a number of magnetite lenses outcropping along a creek over an area about 200 feet long by 50 or 60 feet in width. The rocks here consist of hornblende porphyrite cut by granite, and most of the lenses have formed along the contact or in the granite near it. A small lime inclusion occurs at one point in the granite. The lenses so far explored are small, but carry considerable chalcopyrite in places and have yielded some good ore. A tunnel, designed to cut the line of lenses at a depth of 110 feet, has been driven into the hillside for a distance of 370 feet. The tunnel pierces granite for 300 feet, then a zone of altered rock holding some iron, and terminates in porphyrite. No large body of ore was encountered. The absence of ore along the line of the tunnel does not conclusively prove that the lenses are confined to the surface, and a drift from the tunnel along the granite-porphyrite contact will be necessary to test this point.

Moresby Island.—The Moresby Island mineral claim is situated some distance south of the Copper Queen at an elevation of 750 feet above sea-level. A porphyrite-lime contact crosses the claim, and both rocks for some distance back from the contact are altered, and mineralized with the usual contact metamorphic varieties. Garnet is present in considerable quantities, and also epidote and calcite. The metallic minerals include chalcopyrite, pyrite, zinc blende, and a little magnetite. The development work on the claim is limited to a few small open-cuts and some stripping, insufficient to determine either the extent of the mineralized area or the quality of the ores.

Iron Mountain or Magnet.—This claim is situated about a mile from Harriet harbour, on the divide between it and Huston inlet, at an elevation of about 1,300 feet above sea-level. It contains a large magnetite body about 400 feet in length, with a width at one point of fully 100 feet. The magnetite is enclosed in porphyrite, except at the north end, where some crystalline limestone is exposed. It is unusually free from impurities, on the surface at least, but contains some garnet, epidote, calcite, and cores of more or less altered country rock. Iron and copper sulphides in small quantities and some blende are also irregularly distributed through portions of the mass. The magnetite is reported to assay from $2 to $3 in gold. It has remarkable magnetic qualities and acts as a natural lodestone. The development work consists of some stripping, a surface cross-cut to determine the width of the ore body, and a short tunnel along the foot-wall.

Dingo.—The ore outcrops on the Dingo claim consist of a magnetite lens 10 to 15 feet in width. The lens is exposed by surface cuts at two points about 60 feet apart, and is said to be traceable for a considerable distance. The surface exposures contain little or no copper.

Magnetite lenses also occur on the Reco, Modoc, and other claims in the vicinity.

Copper Island.

Copper island is situated in Skincuttle inlet, about 4 miles north of Jedway. The island is about half a mile in diameter, and several claims have been staked on it, now mostly owned by A. Heino. A wide band of massive greyish crystalline limestone crosses the island, and is bordered by a dark medium grained basic intrusive resembling a diorite but classed with the hornblende porphyrites. The mineral occurrences consist of a number of small quartz and calcite veins, occasionally carrying a little copper, traversing the porphyrite, and an irregular but extensive contact metamorphic zone along the lime-porphyrite contacts, both rocks as usual being affected. Garnets have developed in large quantities, and are accompanied by smaller amounts of epidote, hornblende, calcite, and quartz. The metallic minerals present include the two copper sulphides chalcopyrite and bornite, pyrite, and some scattered magnetite. In addition to these a small veinlet of tennantite, and some cuprite, both probably derived from the sulphides, occur at one point.

The contact metamorphic zone on Copper island is the most typical one seen in the district, and the geological conditions are very similar to those in the vicinity of the rich copper deposits of Texada island. The exploratory work consists of a short tunnel and some shallow pits and shafts. A few tons of picked ore have been shipped, but no large ore body of commercial value has so far been found.

A large number of claims have been staked on Huston inlet and Burnaby island, but as little development work was in progress on them, they were not examined.

Klunkwoi Bay and Vicinity.

From Jedway northwest along the coast to Lockeport, a distance of about 40 miles, while claims have been staked at various points, little mining is being done.

In the vicinity of Lockeport, also, although practically the whole country has been staked, few of the claim holders are doing more than the necessary assessment work.

Swede Groups.—The principal claims near Lockeport, or at least those on which the most work has been done, are known as the Swede group. They are situated on a steep-sided, wooded ridge about half a mile wide and 1,000 feet high, bordered on both sides by inlets from Klunkwoi bay. The group is formed of eight claims extending across the ridge.

The country rock is a dark, medium to rather coarse grained diabase, often amygdaloidal in character. The cavities in the amygaloidal variety vary in size up to about half an inch in diameter and are filled principally with yellowish green epidote, usually accompanied by subordinate quantities of quartz and calcite, and more rarely, chalcopyrite and pyrite. The diabase is quite massive, showing in hand specimens no sign of crushing. It is crossed by a few strong fissures, but is not conspicuously fractured or jointed. Epidote has developed abundantly in certain areas, partially replacing the original constituents, but as a rule the alteration is not excessive. Occasional limestone inclusions, none seen being conspicuously mineralized, occur in the diabase, and it is also crossed by a few dark basic dikes.

The ore consists simply of the diabase, usually more or less epidotized, sparingly impregnated with chalcopyrite and occasionally a little bornite. The chalcopyrite occurs in grains, small aggregates, and tiny veinlets scattered through the close textured, more or less altered diabase and also in the filling of the amygdules in the vesicular variety. It is irregular in its distribution, and seems to occur in patches often of considerable extent, alternating with barren areas.

The development work on the Swede group consists of several long open-cuts, all showing mineral situated at intervals up the steep mountain side to a height of 700 feet, and two tunnels near sea-level, over 100 feet long. The tunnels were driven by I. Wolffsohm, of Vancouver, who now holds the property under bond. Ore in wide irregular patches occurs along both tunnels, but except in spots appears to be low grade. A general sample from a 75 ft. face in one of the open-cuts, collected by Mr. Fleet Robertson, Provincial Mineralogist for British Columbia, is stated by him to have yielded a little over 2 per cent copper with traces of gold and silver.[1] This probably nearly represents the average copper tenor of the diabase in the larger mineralized areas, judging from the present limited exploratory work.

The outline of the copper-bearing diabase has not been defined, but it is known to outcrop over an area of several square miles, and numerous locations have been made on it at widely separated points. It is quite possible and even probable that with further prospecting higher grade ore in quantity will be found.

The genesis of these peculiar deposits is not fully understood. The intimate intermingling of the sulphide grains with the other rock-forming minerals in some specimens gives the impression that the chalcopyrite formed one of the original constituents. On the other hand, the occurrence of the chalcopyrite in the amygdules and in small veinlets as well as in grains, and the occasional highly altered and epidotized condition of the diabase in its vicinity render this view unlikely; and it is more probable that they are of pneumatolytic origin and that the sulphides were deposited from gaseous emanations possibly emitted from the still liquid lower portion of the diabase magma after the upper part had cooled. The strong fissures occasionally seen cutting the diabase and the dikes which intrude it have had no apparent effect on the mineralization, and both are probably younger.

Nelson Group.—These claims are situated near Lake Anna, on the trail from Klunkwoi bay to Tasoo harbour. The country rock in the exposures seen at the lake shore is a dark basic intrusive resembling that at the Swede group, and the mineralization, consisting of an impregnation of the altered country rock with chalcopyrite, is also very similar. The development work has only begun, and the extent of the mineralized area is not yet known.

Magnetite lenses are reported in the mountains south of the lake, but were not visited.

Apex Claims.—The Apex claim is situated about a mile southwest of Lake Anna, near the crest of the high mountainous ridge which forms the watershed of the island.

[1] Report of the Minister of Mines, B.C., 1907, p. 70.

The ridge has a general elevation here of about 2,700 feet, and is surrounded by occasional peaks rising 200 or 300 feet above it.

The rocks at the claim consist of a lime wedge, about 100 yards wide on the surface, enclosed in a greyish granitic rock, both cut by porphyrite dikes.

A short distance below the sharp crest of the ridge a large magnetite lens outcrops on the south slope, and apparently extends through the ridge, here about 400 feet across; as a similar magnetite is exposeed at about the same elevation on the north slope. The lens on the south slope has a maximum width of 50 feet and is traceable up the mountain side for a distance of about 100 feet. On the north slope the maximum width is 125 feet and the height about 60 feet.

The magnetite formed in and replaced a portion of the limestone, near its contact with the granite. It includes a number of limestone cores and also small areas made up mostly of garnet and calcspar. It is stained nearly everywhere on the surface with copper carbonates, and in places chalcopyrite is fairly abundant. The copper tenor, judging from the surface exposures, seems important, but the percentage is not known as practically no work has been done on the claim.

A second large magnetite mass outcrops on a ridge about half a mile west from the Apex lode. Only small quantities of copper are visible in the surface exposures.

Copper Belle.—This claim is situated in a high basin north of Apex mountain. The claim is crossed by a strong porphyritic dike. The showing consists of a magnetite lens about 20 feet in width bordering the dike. The magnetite carries considerable chalcopyrite in places.

Albia Claim.—The Albia is situated in the Apex basin northeast of the Copper Belle. The country rock is an altered greenstone, probably a porphyrite cut by a porphyrite dike. Near the dike the country rock is crushed on the hanging-wall side for a distance of 10 to 15 feet and impregnated with pyrites. Gold values of $10 per ton are reported to have been obtained from a zone 4′–8″ in width bordering the dike.

Tasoo Harbour.

Tasoo harbour is on the west coast opposite Lockeport, and is reached from the latter point by a trail 3½ miles in length. The trail starts from an inlet of Klunkwoi bay, south of Lockeport, climbs 500 feet to Lake Anna and a further 1,300 feet to the summit of the dividing ridge. The descent to the west coast is rapid, the flats bordering it being reached in less than a mile from the summit.

A second trail from the head of Crescent bay has been built by the Provincial government. The summit crossed by this trail is reported to be very low, only 200 or 300 feet in height.

Tasoo harbour is probably the best of the few harbours on the west coast, but is difficult to enter except at slack tide, owing to the rapid current produced by the water forcing its way through the narrow outlet. It is a large irregular body of water over 15 miles in length, consisting of a wide central portion and three deep bays known as the North and South arms and Botany bay. It has never been surveyed, but is said to have over 100 miles of shore-line. It is surrounded on all sides by high ridges and mountains wooded up to a height of 2,000 feet and bare above, which rise from the water at angles often exceeding 50°.

Geology.—Only a portion of the harbour was examined. The rocks seen consist mostly of intrusives similar to those on the east coast. A medium grained greyish granitoid rock classed as a granite outcrops around the head of Botany bay, and is also found on the South arm. It intrudes a dark basic rock referred to the hornblende porphyrite group. Both intrusives are cut by numerous porphyrite dikes, and also hold occasional inclusions of limestone.

Contact Group.—This group includes a number of claims staked on a ridge south of the head of Botany bay. The present workings are situated on the summit of the ridge, at a height of 2,400 feet above sea-level. The country rock here is an altered greenstone, much fractured, and crushed almost into a schist in places. It is cut by a number of dikes, mostly porphyrites, but including a few which are apparently apophyses from a large granite area crossed ascending the ridge.

The showings consist of a number of irregularly distributed magnetite lenses enclosed in greenstone. The magnetite is oxidized on the surface and the red outcrops are very conspicuous, but the present open-cut workings have not so far disclosed any large body carrying copper in commercial quantities. The principal minerals associated with the magnetite are chalcopyrite, pyrite, pyrrhotite, epidote, and garnet.

A large magnetite lens is stated to outcrop some distance below the present workings, on the crest of the ridge, but was not seen.

Warwick Group.—These claims are situated south of the entrance to the South arm of Tasoo harbour, and are distant about 8 miles from the end of the Lockeport trail at the head of Botany bay. The principal workings are at an elevation of 1,160 feet above sea-level, and 2,000 feet from it in a direct line.

The country rock is a dark, medium-grained hornblende porphyrite, holding a large inclusion of crystalline limestone. The mineral showings occur partly in the limestone and partly in the porphyrite, and consist of magnetite in unusually large masses, associated with chalcopyrite, pyrite, and pyrrhotite.

Development work was commenced on these claims in June of the present year, and has been pushed energetically. Besides considerable surface work, consisting of trenching, stripping, and open-cuts to define the ore bodies, a tunnel 100 feet in length has been driven into the main magnetite mass. The tunnel section consists mainly of magnetite, alternating at one point with a band of limestone 15 feet in width and cut by some dikes. Magnetite interbanded with limestone is also shown by surface exposures to extend 100 feet beyond the end of the tunnel. The full length of the ore body is not yet known.

The magnetite is associated with chalcopyrite in grains and bunches, pyrite, and pyrrhotite. The non-metallic secondary minerals usually accompanying similar deposits are not conspicuous. The copper sulphides occur somewhat plentifully in the magnetite near the two ends of the tunnel, and in smaller quantities along the central portion. A considerable proportion of the material extracted is considered by the management to be of shipping grade, but the average copper tenor was not ascertained.

A second magnetite mass, which has apparently developed in porphyrite, as no limestone was seen, occurs 800 feet northwest of the one tunnelled. It has not been fully defined, but is of large size—fully 100 feet in width and 200 feet in length, at least. Magnetite outcrops, probably marking a line of lenses, are also stated to extend down to the beach.

GENERAL SUMMARY.

Principal Metallic Minerals.

Magnetite.—This is much the most abundant mineral seen. It occurs in irregular-shaped areas, varying in size from small bunches to great masses 300 to 400 feet or more in length, in long vein-like forms, and in grains disseminated through the altered rocks. It is usually associated with iron and copper sulphides, garnet, epidote, and other contact metamorphic minerals.

Pyrrhotite.—Pyrrhotite is common in most of the magnetite lenses and in the altered areas. No high gold values have so far been found in it.

Pyrite.—Pyrite occurs with the magnetite, but is less abundant than pyrrhotite. A pyritic zone on the Albia is said to carry fair gold values.

Chalcopyrite.—This is the principal valuable mineral worked at present. It occurs in grains and bunches in practically all the magnetite lenses; in altered contact zones; in shear zones, as at the Lily, associated with the iron sulphides; and impregnating in small quantities considerable areas of altered diabase. Its distribution in the magnetite lenses is erratic, and the proportion present is also very variable.

Bornite.—Bornite occurs in small quantities associated with chalcopyrite on the Oceanic, on Copper island, and in the copper-bearing diabase of Klunkwoi bay.

Tennantite.—A small vein of tennantite occurs in the altered contact rocks of Copper island.

Cuprite.—Cuprite is found in small quantities on Copper island.

Sphalerite.—Sphalerite occurs sparingly in some of the magnetite lenses, and in the altered contact zone.

Gold and Silver.—A small calcite vein carrying free gold occurs at Ikeda bay, and most of the sulphides carry small values in gold and silver.

Gangue Minerals.—The gangue minerals consist of the usual contact metamorphic varieties. Garnet and epidote, the most abundant of these, are present in some quantity in nearly all the mineral occurrences seen. They occur as individuals and in small aggregates both in the ore and adjoining country rock, but have seldom developed in sufficient quantities to form large pure masses as in the Whitehorse district. Other gangue minerals commonly present are calcite, quartz, hornblende, augite, and chlorite.

Character of Deposits.

With the exception of a few small quartz and calcite veins of questionable value, practically all the mineral occurrences seen are replacement deposits, most of them situated at or near lime-porphyrite or granite-porphyrite contacts. A few occur in the interior of the intrusive masses, some of which follow evident shear zones, while others are indistinguishable in appearance and contents from the ordinary contact lodes.

The majority of the ore bodies consist of irregular-shaped masses of magnetite, most of them small; but a few measure from 100 to 400 feet in length and 100 feet or more in width.

The magnetite lenses always carry iron and copper sulphides in some quantity, and occasionally chalcopyrite is developed, in portions of the mass, in sufficient quantities to constitute shipping ores. The gold and silver values found so far are small.

The typical irregular-shaped magnetite lenses grade into long vein-like forms. These, in some instances, have magnetite as the principal vein filling, and in others chalcopyrite and the iron sulphides are the chief minerals present.

The gangue, in both the magnetite and sulphide ore bodies, consists of the country rock in which they developed, usually more or less altered and partially or wholly replaced by secondary minerals.

The peculiar low grade copper deposits in the Klunkwoi diabase are described on a previous page, in connexion with the Swede group. In them, chalcopyrite, sparingly distributed through the diabase, and epidote, are the principal minerals present.

Present Status of Mining.

While iron and copper minerals have been known to exist in the Queen Charlotte islands for several decades, the present activity in mining practically commenced in 1906. Since then prospecting has been vigorously prosecuted, and has resulted in the

discovery of several extensive mineralized areas in which nearly 1,300 claims have been already staked. A large percentage of the discoveries consists of small and medium sized magnetite lenses of doubtful value.

While prospecting has been active, development work has proceeded slowly, and few of the numerous discoveries have been tested even superficially.

The Lily mine, the only one on the island on which any considerable amount of work has been done, has been proven to contain two important ore bodies, one high grade and the other low, and shipments totalling over 8,000 tons have been made from them. Small shipments have also been made from the Oceanic and from Copper island.

During the season development work was in progress on the claims owned by the Collison Bay Mining Company on Collison bay, and on the Contact and Warwick groups in Tasoo harbour. A small amount of work, principally necessary assessment work, was also done on a number of other claims.

The deposits of the so-called contact-metamorphic group are characteristically bunchy and uncertain both in permanence and tenor of valuable minerals, and only occasionally, as experience on the coast has shown, have the tonnage and values necessary to make important mines. The development work on Moresby island, small as it is, has led to several disappointments, but has also proved the presence of ore of shipping grade at a number of widely separated points, although only rarely in quantity. The results obtained so far, measured by the amount of work done, are not unfavourable, and warrant more energetic development work than is being done at present.

SOUTHERN VANCOUVER ISLAND.

(Charles H. Clapp.)

INTRODUCTION.

General Statement.

The work carried on by the writer during the past field season, from June 22 to September 17, in the southern part of Vancouver island, was entirely of a reconnaissance nature, although detailed work was done by his assistant, John A. Allan, assisted by F. J. Barlow, on the east coast. During the last month, Mr. Allan extended the reconnaissance farther to the north. The other assistants were: James Caffery, Charles E. Blogg, and Frank Caffery.

The coast line from Point Nopoint to Bamfield creek and the shores of Nitinat lake were first examined. A traverse was made up Jordan river, across the divide and down San Juan river to its mouth. Another traverse was made up Gordon river, with a side trip up Bugaboo creek, across the divide and down Sutton Creek valley to Cowichan lake. Three weeks were spent at Cowichan lake and immediate neighbourhood. The low divide at the west end of the lake was then crossed, and the coast reached by way of Nitinat river and lake. The rest of the season was spent examining the eastern and southern shores of Barkley sound and Alberni canal. Mr. Allan spent the last month in the field on a reconnaissance across the island between Mount Brenton and Alberni.

Location and Area.

The geological reconnaissance was confined to the southern part of Vancouver island. In the past and preceding seasons, the area to the south of the Alberni-Nanaimo road and to the east of Alberni canal and Barkley sound, has been explored, covering, in all, roughly 4,000 square miles. The examination was necessarily confined to the more accessible parts, and no work was done on the east coast north of Ladysmith.

Previous Work.

In the area explored, little previous work had been done, for Selwyn, Richardson, and Dawson, of the Geological Survey, confined their attention to the extreme south-eastern part and to the coal-bearing rocks of the east coast. Later, Dawson examined the northern part of the island. In 1902, Webster and Haycock, on behalf of the Geological Survey, made a cursory examination of the west coast of the island. The writer's own work of 1908 did not extend into the area examined during the past season. Considerable work of a less general nature has been done by the Provincial Department of Mines, in special, scattered localities. Mr. E. Lindeman examined the iron ores of Vancouver island for the Mines Branch in 1907, and reported upon the iron deposits of Gordon river in the Summary Report of the Mines Branch for 1907-1908.

Summary and Conclusions.

The rocks of the southern part of Vancouver island are largely crystalline. Two main formations occur: the Victoria group and the Vancouver group. The Victoria group is the older, and is provisionally assigned to the Palæozoic. It forms a broad belt underlying the southern part of the area, and consists of slates and schists, metamorphosed basic volcanics, and marbles.

The Vancouver group is lower Mesozoic in age. It consists chiefly of volcanic rocks, largely basic types, but dacites and quartz porphyries occur. The basic members have been altered to greenstones and schists. Some of the volcanic rocks, probably of the upper part of the series, are interbedded with slates and shales.

The above formations have been subjected to mountain building forces and invaded by stocks and batholiths. The plutonic rocks have a wide range of composition, but the chief rock type is granodiorite; they are correlated with the Coast Range batholith of the main coast, which probably is upper Jurassic in age.

During the Cretaceous, the sedimentary rocks forming the Cowichan group were deposited unconformably upon all of the above crystalline and metamorphosed rocks. It is probable that sedimentation was not continuous throughout the Cretaceous, but that the group consists of two or more distinct formations.

In late Cretaceous or early Tertiary time, the Cowichan group was folded, and it has suffered from the same erosion that planed off the underlying crystalline rocks. The detritus of this Tertiary erosion was in part deposited in marine basins along the southern and western shore of the island.

In the Glacial Period, the island was covered by an ice cap. Glaciers occupied the principal valleys and widened and deepened them. On the retreat of the ice, the morainal deposits were variously modified, and the present thick mantle of drift is of slide, fluviatile, lacustrine, and marine origin.

With the exception of the coal deposits of the east coast, the mineral resources of the area have been but little developed. These resources, although possibly not extensive, are varied and of prospective interest. Gold occurs in the gravels of the streams draining the area underlain by the Leech River slates, and has been derived from very low grade, quartz veins in that formation. The gravels are usually quite rich, but are not very abundant. Large accumulations of gravel at the old mouth of Lost river and near the mouth of the present Sombrio river, are being exploited at present.

Copper prospects are numerous, and some ore has been shipped from the Gladys mine on the Alberni canal. The deposits are chiefly developed in the contact-metamorphosed limestones of the Victoria and Vancouver groups, and are, as a rule, small, irregular, and of low grade. Some of them are, however, of considerable economic interest. Other copper deposits occurring as disseminations in shear zones and as veins in sheared rocks, are of little importance.

Large bodies of magnetite occur along the contact of the Nitinat limestones and diorite. The bodies are large, and low in phosphorus; but high in sulphur. The chief deposits occur in the valleys of Gordon river and Bugaboo creek.

The limestones of the area furnish ample material for flux, and for the manufacture of lime and cement. Low grade clays occur in the stratified Pleistocene and recent deposits. Good building stones are not abundant; but some of the granites, marbles, and sandstones are possibly suitable for this use.

Coal is apparently absent from the areas of Cretaceous rocks other than the measures of the east coast, and it is almost certainly absent from the Tertiary sediments of the west coast.

GENERAL CHARACTER OF THE DISTRICT.

Topography.

The whole of Vancouver island is mountainous save for a relatively narrow strip of lowland along the east coast. With the exception of a few isolated peaks and a more or less broken chain of mountains in the central part, the elevations are characteristically flat-topped or ridge-like. This type of topography is the rule in the southern part of the island, where the mountains and ridges rise rapidly from the shore to a height of about 2,000 feet, and continue to rise inland to heights of 4,500 to 5,000 feet north of Cowichan lake, with, however, a few mountains rising a few hundred feet above the general level of the ridges.

North and west of Cowichan lake a more or less continuous mountain chain extends to and culminates in Mount Arrowsmith: a mountain with several rocky peaks, the highest of which is nearly 6,000 feet above sea-level. The mountain chain extends southeastward from Mount Arrowsmith to Mount Moriarty, and then forks: one chain extending to Mount Benson, west of Nanaimo, and another to Mount Brenton and farther eastward, where it forms the low Mount Sicker range. This more mountainous country, with rock peaks and small perpetual snow fields, is from 10 to 15 miles wide. The greater number of the peaks are under 5,000 feet above sea-level, but all are rock peaks and have been carved by local glaciers. They are, therefore, in great contrast to the flat-topped ridges and cone-shaped mountains, usually covered by timber, which occur to the south and east.

From the nature of the mountains as a whole, it appears that they have been formed by the dissection of an uplifted, old erosion surface. The old surface or peneplain was probably developed in early Tertiary times and unlifted during the Pliocene. Into this peneplain many rivers have cut deep and broad valleys, many of which have been still further deepened and widened by glacial abrasion. The trend of the most important of these valleys is either northerly or westerly. Among the more important northerly trending valleys, the Nitinat and Alberni valleys and the lower part of Klanawah valley have been widened and deepened by glacial scouring, while the others do not depart greatly from the V-shaped character. The more important east and west valleys are broad, this feature being in part due to glacial scour, but they are, however, subsequent valleys dating at least from Cretaceous times, as some of them are underlain by sediments referable to that period.

Alberni valley has been drowned, and it now forms the southernmost of the great fiords which indent Vancouver island from the west. Nitinat lake is only a few feet above low water, and at high tide the salt water rushes into it through a narrow rock gate. With the exception of these two inlets and two broad bays—San Juan harbour and Pachena bay—the west coast between Point Nopoint and Barkley sound is very straight and affords little or no shelter. This character, so unlike that of the coast north of Barkley sound, is due to the structure and uniformity of the comparatively recent Tertiary sandstones and conglomerates which form the greater part of this coast.

Climate and Vegetation.

The climate of the area varies widely in different parts. Along the west coast it is exceptionally wet, with almost 120 inches of rain in a year, while on the east side of the island—in the lee of the main range—it is comparatively dry, with from 30 to 60 inches of rain per year. The temperature along both coasts is remarkably uniform, owing to the influence of the Japan current. The average temperature is 40° F. in winter, and 55° F. in summer. On the mountains the differences in temperature are, of course, much greater.

Virtually the entire area is heavily forested; the chief forest trees being fir, cedar, spruce, balsam, and pine. The timber is in places of little value owing to old windfalls, snowslides, and forest fires; but over large areas is of excellent quality. The western part of the area and the valleys are covered by a dense underbrush, composed chiefly of salalberries, huckleberries, and salmonberries, which, in places, are so thick as to be well-nigh impassable.

As yet there is little agriculture, and there is only a comparatively small part of the land suitable for farming purposes; not more than 10 per cent. Relatively narrow strips bordering the rivers and lakes furnish good land, which, however, must for the greater part be cleared of heavy, thick timber. Occasional, open meadow lands occur, especially in the interior.

Means of Communication.

Fiords, lakes, and rivers, and a few roads furnish ready access to the interior of the island, and no very long inland trips need be made. Such trips at the present time must be made without the aid of pack animals, as the trails are not numerous and, with two or three exceptions, are only suitable for men.

GENERAL GEOLOGY.

Table of Formations.

A provisional classification, based on the past two seasons' field work, of the formations exposed on the southern part of Vancouver island, is as follows:—

Superficial deposits	Pleistocene and Recent.
Sooke formation Carmanah formation	Tertiary (Oligocene Miocene).
Cowichan group	Upper Cretaceous.
Nanaimo, in part.	(May include lower Cretaceous and Jurassic.)
Dike intrusion	Upper Jurassic?
Batholithic intrusion	Upper Jurassic?
Granodiorite.	
Diorite and monzonite.	
Sooke gabbro?	
Vancouver group	Jurassic (or, and,) Triassic.
Metchosin volcanics?	
Mt. Sicker formation?	
Sansum formation?	
Vancouver volcanics.	
Vancouver limestone.	
Victoria group	Upper Palæozoic? Malahat?
Nitinat formation.	
Highland formation.	
Leech River formation.	

General Description of Formations.

Victoria Group.—The oldest group of rocks in the southern part of Vancouver island is the Victoria group. This name was proposed by the writer to include the older metamorphic rocks that occur in the neighbourhood of Victoria,[1] and which were assigned to the Palæozoic, and provisionally, in part, to the Devonian, on the evidence of fossils secured at Cowichan lake. A later, much more complete collection of fossils from the same locality now shows the fauna to be either Triassic or Jurassic. The correlation of the formations is still doubtful, but it is probable that a large part of the rocks assigned to the Victoria group belongs to an older group of rocks than those in which the above fossils occur, and they are still assigned, provisionally, to the Palæozoic.

In the area explored during the past season, the following formations are exposed: the Nitinat limestones, the Highland volcanics, and the Leech River slates.

The Leech River slates form a belt of rocks 5 to 8 miles wide, extending westward from Leech river to the west coast. To the east of Jordan meadows, in the area examined in 1908, the belt narrows and is not exposed north of the Metchosin volcanics on the east coast. The southern contact, which is with the Metchosin volcanics, is a profound fault extending from the Royal Roads to the west coast near the mouth of Sombrio river; a distance of about 40 miles. The northern contact is marked by the San Juan valley and its eastward extension, Meadow creek. The contact is straight, and probably is a fault; in the eastern part of the area it is with the volcanics of the Highland formation, while towards the west it is with the Nitinat limestones.

[1] Summary Report, 1908, Geol. Survey, Canada, p. 55.

The Leech River formation is composed chiefly of slates and slaty schists. Many of them are dark coloured, and graphitic schists are abundant. Greywackes and quartzose schists also occur. The rocks have a general eastward trend parallel to the strike of the belt as a whole. The dips are high and usually to the north. The beds are also contorted. It is probable that the entire formation has been folded into one or more close, nearly isoclinal folds.

In the eastern part of the area, the Leech River slates are in contact with closely-folded metamorphosed basic volcanics, chiefly tuffs and agglomerates, but including some porphyries. These rocks are provisionally assigned to the Highland formation. They are also exposed on the divide between the headwaters of Jordan river and Floodwood creek, with the Leech River slates on either side. They also form a belt lying north of the Leech River formation and extending from the North Fork of Leech river to Haro straits, east of Victoria.

The Nitinat formation occurs north of the Leech River slates, forming a belt 10 to 12 miles wide and extending westward from the mouth of Gordon river to Barkley sound, a distance of over 30 miles. The northern contact is with the altered volcanic rocks of the Vancouver series. The distribution of the rocks east of Gordon river is not known; possibly they may be represented farther east by the Malahat limestones.

The rocks of the Nitinat formation are calcareous. There are many areas of pure white, coarsely crystalline limestone, but a large portion of the limestone appears to have been profoundly altered by invading magmas into siliceous and feldspathic 'contact rocks' as well as amphibolites. The formation over wide areas has been replaced by the batholith of diorite and granodiorite, and the remaining areas are of the nature of huge 'roof pendants.' The strike is, in general, about N 65° W; the dips are all high.

Vancouver Group.—The Vancouver group embraces the great bulk of the crystalline rocks underlying the central part of the island. The group extends from the east coast to Alberni canal; in the central and western part of the area, the belt is 35 to 40 miles wide, but narrower to the east. The southern contact is with the Nitinat formation. In the eastward extension it may be with the Malahat formation, or the group may possibly include some of the volcanic rocks of the Highland formation. Along the northern boundary, the rocks are in unconformable contact with the Nanaimo group, which forms a relatively narrow band along the east coast.

The great bulk of the rocks of the Vancouver group are volcanics, chiefly basalts and andesites. They have all been metamorphosed and in part recrystallized, though not rendered typically gneissoid, and are seamed with quartz and epidote. Intrusive dikes and sills of fine-grained, basalt porphyrites occur.

Crystalline limestones in masses more of the form of rather large lenses than of beds, occur interbedded with the volcanics. The contacts are irregular, and small pieces of partially altered limestone occur within the basalt flows. The limestones are typically very finely crystalline, sometimes white or grey of colour but more commonly blue. They have been crushed, broken, and recemented by calcite veinlets. On the south shore of Cowichan lake, east of Croft creek, a lense of much less altered limestone occurs that in places consists largely of fragments of organisms.

North of Cowichan valley is a belt extending interruptedly from the east coast to near Alberni, which consists of shales and tuffs with interbedded porphyries and intrusive masses of gabbro-diorite porphyry. These rocks, described last year as the Mount Sicker series, undoubtedly form one of the formations making up the Vancouver group.

The Sansum formation is shown by Mr. J. A. Allan[1] to be conformable with the Mount Sicker formation, and hence belongs to the Vancouver group.

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[1] See Summary Report of J. A. Allan.

Rocks similar to those of the Sansum formation are found in Chemainus valley, where they appear to be conformable with and transitional into the schists of the Mount Sicker series, yet cannot be separated from the shales of the Nanaimo group, and, therefore, though probably belonging in part, at least, to the Vancouver group, they are described under the general name of Cowichan group.

The Metchosin volcanics form the southernmost belt of crystalline rocks occurring south of the Leech River formation, and extend from the Royal Roads to the west coast. The formation consists entirely of volcanic rocks having a diabasic habit. They are much less altered than the volcanics of the Vancouver group, and contain no calcareous members, and, therefore, are only provisionally assigned to the Vancouver group.

The strike of the rocks of the Vancouver group, though locally varying greatly, is, in general, N 65° W, while the dips are high. The determination of the age of the group rests on their lithologic similarity to the rocks of the northern part of the island as described by Dawson and grouped by him under the name of the Vancouver series,[1] and on the fossils collected at Cowichan lake. This fauna, previously thought to be possibly Devonian, has, on the evidence of a more complete collection, been determined by Professor H. W. Shimer, to be upper Triassic or lower Jurassic.

Batholithic intrusion.—Intrusive into the Victoria and Vancouver groups are large plutonic masses. Although at the surface these masses are not usually connected, at a depth they probably are, since they are very similar in composition and relationship. The individual masses are often separated by very narrow belts of the overlying formations, and their outlines are very irregular.

As a whole, the batholith underlies the entire central part of the island. An almost continuous section of plutonic rocks occurs along Barkley sound and Alberni canal; while along the east coast, from Victoria to the central part of Saltspring island, they form a number of large bodies. Small masses have been intruded into a broad belt in the central part of the area near Cowichan lake, and to the south for 8 to 12 miles. A large body occurs in the catchment of the Franklin river and Granite creek, while the same general batholith is exposed to the eastward nearly to Ladysmith. Other similar intrusive masses are common throughout the area.

The chief rock type is granodiorite, though where intrusive in the Nitinat formation, diorite, sometimes monzonitic in character, is always in contact with the limestones. The diorite is cut by the more acid granodiorite. The granitic rocks have been broken and sheared extensively; many of them are gneissic, and all have been subjected to thermal metamorphism.

The plutonic rocks are intrusive into the Vancouver group, and the Nanaimo group (upper Cretaceous) rests unconformably upon them; they are similar to those of the Coast Range batholith and are correlated with them.

Dike intrusions.—With the exception of the volcanic intrusives, relatively few dikes were observed. A small number of andesitic and trap dikes cut the granitic rocks, and are apparently directly connected in origin with the batholithic masses. The Leech River slates are, however, intersected by irregular, fine-grained, basic dikes possibly not belonging to the same main period of igneous intrusion.

Cowichan group.—Throughout the region are long, trough-like areas of relatively unmetamorphosed sedimentary rocks belonging to at least two unconformable groups and possibly more. The different groups are, however, lithologically, very similar, and for the present are grouped together under the general name of Cowichan group. The members of this group occur in usually closely-folded, down-warped areas, and, being sediments and, therefore, more easily eroded than the crystalline rocks, occupy broad valleys which have, in general, a trend between N 60° W and N 80° W.

[1] Dawson, G. M., Report on a Geological Examination of the Northern Part of Vancouver Island and Adjacent Coasts, Ann. Rep. Geol. Surv., Can., 1886, p. 10 B.

The principal area occurs along the east coast, where the rocks belong to the Coal Measures and contain the coal seams mined at Nanaimo and Extension. The other areas are in the Cowichan valley, the upper parts of Chemainus and Koksilah valleys, and Alberni valley.

The rocks of the Cowichan series are conglomerates, sandstones, and shales—the shales predominating. The basal members are conglomerates and sandstones, often composed of detritus from the basic volcanic rocks, and have a characteristic greenish colour. The shales are dark coloured and highly carbonaceous; in places they pass into slates and apparently into graphitic schists interfolded with the chlorite schists of the Mount Sicker formation.

In the Chemainus valley, and apparently also in the Koksilah valley, there appear to be two unconformable series of sediments within the group. The lower, consisting of shales and slates, is interbedded with tuffs and dacites of the Mount Sicker formation, and is cut by andesitic dikes and gabbro-diorite porphyry. These sediments should probably be correlated with the Sansum formation. They are overlain unconformably by a group of sedimentary rocks similar to those of the Cowichan valley.

The lower series exposed in the Chemainus valley almost certainly belongs to the Vancouver group, but the larger portion of the Cowichan group is clearly unconformable upon the Vancouver group and the granitic rocks, and is, therefore, of Cretaceous age. They may be of the same age as the Nanaimo group, that is upper Cretaceous, for they are apparently continuous stratigraphically to the east coast where the rocks are almost certainly of the Nanaimo group. They are, however, more metamorphosed than the rocks of the Nanaimo formation, and are, apparently, not coal-bearing.

Carmanah and Sooke Formations.—Along the west coast, from Beecher bay westward nearly to Pachena bay, occurs a narrow strip of sediments, chiefly conglomerates and sandstones, of Tertiary age. They have been divided by Merriam[1] into the Carmanah and Sooke formations.

The Tertiary sediments form a series of elongated basins seldom more than a mile in width, separated by relatively narrow ridges of the underlying crystalline rocks. The sediments consist of coarse basal conglomerates and sandstones with, in the larger basins, thin-bedded, shaly sandstones and occasional thin lignite seams. The beds are comparatively undisturbed, with gentle dips to the southwest, usually under 10°. The entire thickness of the sediments in any one basin is probably not more than 500 feet, but though lithologically similar throughout, the sediments of the eastern basins contain a stratigraphically higher fauna than those of the western basins, so that Merriam divided them into the Carmanah (Astoria Miocene) and Sooke (upper Miocene or lower Pliocene) formations.

ECONOMIC GEOLOGY.

The ascertained value of the mineral deposits of the district, excluding the coal deposits of the east coast, is not large. The greater part of the area is still unprospected, as prospectors have only explored the principal streams and the shores of the lakes. The development work on the majority of the prospects has been small. The metals that have attracted attention are gold, copper, and iron; silver, lead and zinc ores have been reported. Other deposits of possible value are those of sulphur, coal, fluxes, clay, and building stone.

Gold.

Gold has been known to occur in the Leech river since the sixties, and the gravels and sands near the mouth of the Sombrio river have been known as a source of gold since the days when the Spaniards explored the Pacific coast in the latter part of the

[1] Merriam, J. C., Bull. University of Cal., Vol. 2, No. 3, pp. 101-108, 1896.

eighteenth century. Gold is known to occur throughout the Leech River valley, and is supposed to have been derived from the quartz veins in the Leech River slates.[1] Both the gravels in the actual valley and the higher gravels of the tributary creeks to the north of the valley are known to be auriferous, but the deposits are not extensive and so have not been considered economically important.

A large accumulation of gravel and sand occurs on the coast, near the mouth of Sombrio river. At the present time a partnership composed of Messrs. R. S. Gallop, D. W. Hanbury, and W. H. Kirkbridge, has been formed to build a hydraulic plant to work these gravels, the plant being under course of construction during the past summer. The amount of gravel has been estimated by an engineer employed by the partners to amount to 3,000,000 cubic yards, and as sampled from a bank on the shore, is considered by Mr. Gallop to run over 50 cents a cubic yard. Some of the gold is flaky and fine, but the bulk is apparently fairly coarse.

Auriferous gravels occur in the numerous valleys of the small streams crossing the slate belt, but, as a rule, the amount of gravel is very small. The deposits of gravel in the San Juan valley are probably low grade, as they are largely of glacial origin. Along the west coast in the vicinity of Sombrio river and to the east as far as Jordan river, black sands occur in the beach, and carry gold. The gold is, however, flaky, and the actual amount of black sands is apparently not large. Mr. Gallop, who has prospected the gravels and sands in the neighbourhood, reports the occurrence of native mercury in the sands.

Though it is believed that the gold of the gravels and sands has been derived from the quartz leads in the slate belt, the writer is confident that the quartz veins so far examined are too low grade to be of economic importance.

Placer gold has been sought in Franklin river and China creek, but has not been found in paying quantities.

Mineralized shear zones occur along the contacts of the limestones and volcanics with diorite and granodiorite. The deposits of this character are usually more important as possible sources of copper, but they also carry small amounts of gold. A typical example is that of the deposit on the Alfreda claim, situated on the east slope of the valley of Gordon river 3 miles above the mouth. Here, the diorite, which includes a block of what has probably been limestone, has been tremendously sheared, forming a zone about 25 feet in width and striking N 50° W. The diorite and limestone have been completely changed to a chlorite and to a graphitic chlorite schist. In this zone lenses of quartz carrying a small amount of pyrite have been developed. The rock is said to assay $2 a ton in gold and 5 ounces of silver. Unless considerably larger and higher grade bodies are found, these deposits are of little or no commercial importance.

Copper.

The deposits of copper-bearing minerals which were examined during the past season are all intimately connected with the granodiorite and diorite batholiths, and usually occur in contact metamorphosed limestones adjacent to the igneous rocks. In these zones the metallic minerals occur as rather small, irregular bodies of magnetite, pyrrhotite, pyrite, and chalcopyrite; intimately associated in most cases with garnet, or they occur disseminated through shear zones at or near the contact. Shear zones in the metamorphosed basalts and andesites also occur, which have been impregnated by copper-bearing minerals. A less important type is that in which chalcopyrite occurs in distinct quartz veins lying in shear zones; notably in the old volcanic rocks.

The contact deposits occur in both the coarsely crystalline limestones of the Nitinat formation and in the compact blue, crystalline limestone lenses which are interbedded with the volcanic rocks of the Vancouver group. They might also be divided into two groups, those which are situated at the contact, and those which

[1] Clapp, C. H., Summary Report, Geol. Surv., Can., 1908, p. 59.

occur higher up in the contact metamorphosed limestones. The former are characterized by a higher percentage of magnetite and pyrrhotite, and the latter by a higher percentage of pyrite and chalcopyrite.

The contact deposits in the Nitinat marbles are rich in magnetite and are of more value for the iron they contain than the copper. The most important of these deposits, those along the Gordon river and Bugaboo creek, are described under the iron deposits. In Barkley sound, deposits containing copper minerals occur on the islands, and also in the Sarita valley about 2 miles above the mouth. The limestones have been altered to the characteristic diopside-garnet rock, and the siliceous and feldspathic 'contact rock,' locally called 'felsite.' They have also been sheared to a great extent. Pyrrhotite is the chief metallic mineral. It occurs disseminated through the sheared rock, often replacing it so as to form irregular masses of nearly pure sulphide. Associated with the pyrrhotite is more or less magnetite, and also chalcopyrite, which occurs as disseminated grains and small gash veins in the pyrrhotite. Sometimes the veinlets or lenses furnish a very high grade ore, but they are small, usually less than an inch in thickness, and none were seen that were more than 6 or 8 inches in width. The deposits are irregular, essentially low grade, and none of those examined are more than a few feet in thickness. The present economic value is, therefore, slight.

Considerable development work has been done on the Sarita River deposit.

Several deposits occur in the limestones of the Vancouver group in the neighbourhood of Cowichan lake. Those above the headwaters of the East Fork of the Robertson river are located near the contact with granodiorite or quartz monzonite. The greater part of the limestone has been metamorphosed to an amphibolite; but when the metallic minerals occur abundantly they are associated with a garnetiferous rock, called by the prospectors garnetite. Higher up, on the ridge, white, crystalline marbles, which are fairly pure, are found. On the 'Hillside' claim, located 400 feet above the river, a body of pyrrhotite and chalcopyrite, 3 feet wide, occurs in the garnetiferous rock. The chalcopyrite occurs in veinlets and lenses in the pyrrhotite up to 8 inches thick. The deposits near the river on the 'Alpha' and 'Beta' claims consist of disseminated magnetite and chalcopyrite in the garnet-bearing rock. The metallic minerals have sometimes replaced the metamorphosed limestone, and on the 'Alpha' claim, near the discovery post, a body 6 to 8 feet wide has been exposed, consisting chiefly of chalcopyrite with some magnetite and garnet. The paragenesis of the minerals is clearly shown in many cases to be magnetite, garnet, and chalcopyrite. The garnet is, however, of more than one order of formation. Some of it occurs as small well developed crystals of green andradite, while the copper pyrites occurs filling the interstices between the garnet grains.

The deposits are not deeply weathered, and the unaltered sulphides occur within a few inches of the surface. Pyrrhotite is often spoken of incorrectly among the prospectors as an 'iron cap,' and they refer to it as if it capped a body of nearly pure copper pyrite. This is a wrong interpretation of the facts, as there can be no enrichment of copper below the surface by the formation of pyrrhotite, as there is when a typical 'iron hat' or gossan is formed. It is readily seen that pyrrhotite has been formed before the chalcopyrite, and as far as the investigations on the copper deposits of the island have gone, pyrrhotite cannot be taken as a good indication of the presence of any large quantity of chalcopyrite. Where the pyrrhotite is not abundant the deposits are at least very favourable prospects.

The contact deposits which have apparently been formed at a higher zone of the contact, occur on Mount Gordon, at the headwaters of the Gordon river, and on the south slope of the Alberni canal near the entrance. The deposit on Mount Gordon may be taken as typical. It occurs a little over a mile west of Gordon bay (Cowichan lake), and several claims have been located on the deposit. It occurs in a contact metamorphosed and much sheared bed of dense blue, crystalline limestone, which is interbedded with sheared and altered basic volcanic rocks. The granitic rocks causing

the metamorphism are not exposed in the immediate vicinity, but doubtless occur at no very great depth. The metallic minerals are pyrite and chalcopyrite, with garnet and quartz as the chief gangue minerals. The absence or small amount of magnetite and pyrrhotite is significant, and apparently shows that the mineralization has taken place at a distance from the actual contact. The garnet zones are narrower and the ore minerals occur most abundantly in the sheared rock, largely altered to a chlorite schist. In the deposit of the Gladys mine, Alberni canal, bladed amphiboles have been formed in the sheared rock. There are small lenses of chalcopyrite in the sheared rock, as well as disseminated grains. The deposits as a whole are low grade, but owing to the absence of magnetite and pyrrhotite, they are one of the more promising types of contact ore bodies.

Some ore has been shipped from the Gladys mine, but as the ore was gouged out without developing the property, it is impossible to gain a fair idea of the extent of the deposit. As a rule the deposits are probably small and irregular.

All of the above types are clearly of contact origin. The proofs are apparently indisputable that the metallic contents were derived from the invading magma. In most cases the original limestone has not only been changed mineralogically but chemically. The definite order of crystallization of the minerals forming the ore deposits shows that they were deposited from solution, and the change in character of the deposits in the higher zones apparently shows—since they contain the last of the metallic minerals to crystallize—that there has been an upward circulation. The nature of the minerals indicates that they have been formed at high temperature and pressure. It is, therefore, most probable that the deposits were formed by emanations from the invading magma.

A contact deposit of somewhat different peculiarities occurs on the divide between the Chemainus river and Cottonwood creek, and has been developed on several claims. The deposits occur in a series of thin-bedded, silicified shales, and quartzite-looking rocks. They are apparently interbedded with the meta-basalts and andesites which occur to the south. They have a general strike of N 45° W, and a dip of about 40° to the southwest. These rocks are cut by dikes and sheets of, or possibly interbedded with, feldspar porphyry. The entire series is cut by granodiorite which underlies the ridge on which the deposits occur at a very shallow depth and is exposed on the slope down to the Chemainus river. These rocks are very similar to those which occur north of Cowichan harbour, exposed along the Sansum narrows, and which were described last year under the Mount Sicker series. They were thought to be largely of volcanic accumulation, with interbeds of shale.

The metallic minerals occur along certain zones, which are characterized by the development of garnet. The garnetiferous beds are interbedded with slaty rocks thought to be tufaceous. The garnet is the lime-iron garnet andradite. The garnetiferous beds are impregnated with pyrite and chalcopyrite, which sometimes occur as lenses or veinlets with or without calcite. Quartz and molybdenite are usually present. Conspicuous in some of the mineralized zones are massive magnetite and pyrrhotite.

The nature of the deposit, characterized by andradite garnet, suggests very strongly that it is a limestone contact. No limestone or marble, distinctly recognizable as such, is, however, exposed in the vicinity. Up to the time of the examination, no limestones or calcareous rocks had been seen in this belt, which apparently extends along the north side of the Cowichan valley more or less continuously to the shore. Later in the season limestones—white marbles—were found in the same belt, but always associated with massive volcanic rocks. The banded rocks were considered last year to consist solely of altered volcanics and shales, and this conclusion was confirmed by Mr. Allan's detailed work north of Cowichan harbour. At the time of the examination the writer was, therefore, quite certain that the deposit was formed by emanations from the underlying granodiorite batholith, in a series of volcanic tuffs, porphyries, obsidians, and shales of sedimentary origin, which rocks had been silicified

and altered by the contact metamorphism. A qualitative examination of the garnet has shown it to be the lime-iron garnet, and a hurried microscopic and qualitative examination of the rocks shows the presence of considerable calcite, which also occurs in the veins, so that it is possible that the garnetiferous bands represent beds of limestone, which were probably impure.

In the schistose andesites and dacites that make up the western extension of the Mount Sicker formation, several claims have been located in sheared zones which have been impregnated with pyrite and chalcopyrite. In all these sheared zones pyrite is much more abundant than chalcopyrite, and the deposits are apparently of little value.

On the 'Brass' mineral claim, of the Jubilee group, a shaft has been sunk on a quartz vein, 18 inches wide, and traceable for about 50 feet along the outcrop. The vein carries pyrite and chalcopyrite, pyrite being greatly in excess. The vein occurs in a mineralized shear zone in the altered basalts or andesites of the Vancouver series.

Similar impregnated shear zones occur in the volcanic rocks exposed along the Nitinat river. Pyrite is the principal metallic mineral. On the surface the whole impregnated zone weathers to deep reddish-brown, so that the mineralization appears superficially to be much more extensive than it really is. Deposits of this type are of little or no value.

In the Metchosin volcanics, shear zones with accompanying quartz stringers which carry metallic minerals occur. A deposit on one of the tributaries of the Jordan, about 3 miles from the mouth, occurs in a dense ophitic basalt, which has been impregnated and replaced along narrow shear zones—the strikes being N 25° E and N 60° W—chiefly by pyrite, with some pyrrhotite and chalcopyrite. These minerals are massive. Cutting the shear zones are quartz stringers up to 4 inches wide. These contain small crystals of pyrite and chalcopyrite. The deposits are small, very low grade, and are apparently of no economic value.

A large number of claims have been staked on a group of deposits occurring at the headwaters of the Franklin river and China creek. These claims were not visited, and their character is not known.

Iron.

On the Gordon river and its tributary, the Bugaboo creek, which empties from the west into the main river about 6 miles above the mouth, are developed large bodies of magnetite which have been exploited for iron. These deposits occur in coarsely crystalline limestones near the contact with diorite.[1]

There are several belts, at least five, of limestone, which are separated by diorite. The diorite, which is apparently a peripheral phase of the granodiorite batholith, is intrusive into the limestone, and is itself cut by the granodiorite. The limestones were originally pure, to judge from the large beds of pure white, coarsely crystalline marble that are found. They have been tremendously altered by the invading batholith, which is to be expected, since the belts of limestones are only 75 to 200 yards wide, and are of the nature of 'roof pendants.' The large one, in which the principal ore deposits are developed, is continuous for at least 3 miles, having a strike of about N 70° W. It is parallel to Bugaboo creek, and occurs on the southern slope of the Bugaboo valley. The limestone has been in part changed to the ordinary siliceous garnet-diopside rock so characteristic of limestone contacts. Much of it has been more profoundly altered to an amphibolite consisting chiefly of hornblende and feldspar.[2]

The igneous rock itself has apparently been subject to change. Although the chief rock type of the batholith is granodiorite, no granodiorite has been noted in direct contact with limestone. The igneous types at the contact are chiefly diorites, some of

[1] The deposits have been described by E. Lindeman, Summary Report, Mines Branch, 1907-8, pp. 36-37.

[2] Compare F. D. Adams. On the origin of the Amphibolites of the Laurentian Area of Canada. Journ. of Geol., Vol. XVII., No. 1, pp. 1-18, 1909.

them monzonitic in habit. At the actual contact a very dark diorite occurs, extremely rich in femic minerals. Since this is a feature only of the limestone contacts, it is to be presumed that the limestone had a profound influence on the invading igneous rock.

Along the Bugaboo Creek belt, as well as along the other smaller strips of limestone, large masses of almost pure magnetite have been found. These vary in size up to masses such as are exposed in the Baden Powell claim, which is 125 feet wide, and about 500 feet in length on the outcrop. The magnetite, although nearly pure, is cut by great numbers of veinlets of pyrite and chalcopyrite. An average of the three analyses from these deposits given by Lindeman[1] is as follows:—

Silica	7·300
Iron	60·850
Sulphur	2·550
Phosphorus	0·048

This, doubtless, fairly represents the better grade of deposits.

An interesting feature is exhibited at the contact of the magnetite body and the marble, which lies below the magnetite, on Bently creek. Apophyses of magnetite have penetrated the pure marble much as apophyses of an igneous rock would an invaded formation. Irregular tongues penetrate and have included fragments of the limestone.

The nature of the deposit is such that there appears little doubt but that the batholith must be looked to for the source of the metallic contents. That the metallic minerals, especially the magnetite, were deposited from very concentrated solutions, is strongly suggested by the intrusive veins exposed on Bently creek.

Other deposits of a similar nature are known to occur in the same formation south of Sarita river, as well as in the more northerly portions of the island.

That the deposits are large and extensive is strongly supported by their occurrence, and by the development work which has already been done. The high percentage of sulphides is extremely undesirable, and will doubtless always be present. Lindeman[1] writes, however, that it is not too high to render the ores unfit for smelting.

Sulphur.

The contact deposits which are rich in sulphides, especially pyrite and pyrrhotite, are possible sources of sulphur. No such deposits were seen in the area examined last summer which were large enough or rich enough in sulphur to be considered as even possible sources of that substance.

Fuels: Coal.

Along the eastern coast of the island the Nanaimo formation occurs, which contains the coal seams which are the source of the extensive industry at Extension and Nanaimo. Large areas of sedimentary rocks of similar lithological characters occur in the region examined this season. These are: the basins underlying the Chemainus river, the Cowichan valley, the upper part of the Koksilah, at Alberni, and a narrow strip along the west coast. These sediments, on account of their lithological similarity to the Coal Measures of the east coast, have been prospected sporadically, yet sometimes quite extensively, for coal. The prospectors have often been encouraged by the presence of very thin coal streaks, or thin lenses of lignite, yet in no case have any deposits of even prospective value been found.

The sediments which fringe the west coast are of Tertiary age (Miocene), and it is evident from the fauna they contain that they are of marine origin. The entire

[1] Ibid.

thickness of the formation which occurs on Vancouver island is not great—probably less than 500 feet. They extend only a short distance inland; in one or two instances over a mile, but usually much less. Almost the entire thickness is fairly well exposed, and no coal is shown. A few thin lenses of lignite are known. Similar deposits in the sediments to the east were considered last year to be of drift origin,[1] and the evidence gathered during the past season bears out this conclusion. It is virtually an assured fact that, these sediments do not contain workable beds of either coal or lignite.

The other sedimentary areas are much older, and may in part belong to the Nanaimo group. However, at the present time, from evidence given in the above section on general geology, it seems probable that part of the sediments belongs to lower formations than the Nanaimo: either lower Cretaceous or Jurassic. Fossil remains of plants, and even thin seams of coaly material, ⅛ to ¼ of an inch thick, are found. No larger seams are known. The sediments have been much more folded and metamorphosed than the known Cretaceous Coal Measures, and are cut not only by basic dikes, but possibly by granitic rocks. From the data on hand, it seems improbable that coal of any great importance occurs in these beds.

Fluxes, Lime, and Cement.

The crystalline limestones afford abundant material suitable for fluxes, also for the production of lime, and for the manufacture of Portland cement. The more compact, finer grained, often blue limestones which occur as lenses in the great mass of volcanic rocks which make up the Vancouver series, are on account of their much smaller size, the altered character of the material, and the numerous dikes or interbeds of porphyry, of less importance. On the other hand, the coarsely crystalline marbles of the Nitinat formation have been profoundly altered by the invading batholith, so that by far the larger bulk of the limestones of this formation is useless for any of the purposes mentioned. However, large belts of relatively pure unaltered marble occur, such as that exposed at the southern end of Nitinat lake to the northeast of the Indian reservation, which afford an ample supply for the establishment of a large industry. At present, none of the marbles of the district are utilized. The only attempt to utilize them was made in the belt exposed on the eastern shore of the Alberni canal opposite Nahmint bay. Although the limestone is apparently of good quality for lime, the attempt was given up without even quarrying much limestone, or burning any.

Clays.

In this district, as in the area examined last season, only low grade clays occur, and these are confined to Pleistocene and recent deposits. None of the shales of the Cowichan series exposed in the area offer suitable material. Most of them have been more or less metamorphosed, and they are all sandy and impure. The superficial clays, largely modified glacial detritus, are also sandy and impure; although some of them, such as those in the neighbourhood of Alberni and those underlying the flat areas and meadows along the west coast and in the principal valleys, would perhaps be suitable for common brick, tile, and the cheaper grades of stoneware. The clays are not used at all, as there is at present no local market, and the wares would not be of such quality as to stand high transportation charges.

Building and Ornamental Stones.

The fractured and sheared character of the formations of the entire district renders the great majority of the rocks useless for building stones. In relatively rare instances the marbles may have escaped fracturing to such an extent that blocks of

[1] See Summary Report, Geol. Surv., Canada, 1908, p. 60.

a fair size may be obtained, and it is very probable that the size and quality of such blocks would improve with depth. The granitic rocks have likewise suffered from the general shearing. However, along the Alberni canal, notably north of Franklin river, a basic granite (granodiorite) occurs which is massive, regularly jointed, and is apparently quite free from small fractures, and which would possibly make a good building stone.

Other stones available are the coarse, thick-bedded sandstones of the Tertiary sediments along the west coast, and some of those of the Cowichan series. In no case does the sandstone seem to be of such a quality as to admit of its profitable export to an outside market, but it might be used for local constructional purposes.

The traps, especially those of the Metchosin formation, offer abundant material for an excellent quality of crushed stone.

SALTSPRING ISLAND, AND EAST COAST OF VANCOUVER ISLAND.

(J. A. Allan.)

LOCATION AND AREA.

The district examined this summer lies on the eastern side of Vancouver island, about 25 miles north of Victoria, between Cowichan harbour on the south and the town of Ladysmith on the north. On the main island this area is about 20 miles long and 4 to 6 miles broad. The southern two-thirds of Saltspring island, comprising an area of about 70 square miles, was also examined. The northern portion of the island was not visited, as it is underlain by rocks of the Nanaimo group—Coal Measures—and an examination of these rocks was not included in the work outlined. The total area covered was between 175 and 200 square miles.

The season's work was, for the most part, of a detailed nature, and occupied the first two months of the field season, of which the first three weeks were spent on Saltspring island. A large part of the area examined is accessible inland by roads, and by boat along the coast. Saltspring island was examined largely from a boat traverse around the shore.

GENERAL CHARACTER OF DISTRICT.

The general relief is low; the greatest elevation being that of Mount Bruce, 2,300 feet above the sea. The hills have well rounded tops, due in part to the action of ice. The slopes are generally steep, are more or less densely wooded, and have a rank undergrowth.

A ridge with a relatively flat top strikes N 70° W across the area, and includes Mount Bruce, Maple mountain, Mount Sicker, and others. On either side of the ridge are flat-topped hills, such as Mount Baynes, Mount Erskine, Mount Tzouhalem, and Mount Prevost.

The valleys in the area run in two directions: the principal ones have a northwest and southeast trend, while others run north and south. On the mainland the Cowichan and Chemainus are the principal valleys. On Saltspring island two well marked depressions with a northwest and southeast trend, divide the island into three rectangular parts. One of these depressions extends from Fulford harbour to Burgoyne bay; the other connects Ganges harbour with Vesuvius bay, and is represented on the mainland by Oyster harbour at Ladysmith.

There are few large streams in the area, this being especially true of Saltspring island. The water is drained off immediately by small, intermittent streamlets. On the mainland, Cowichan and the Chemainus rivers are the only large streams. The first named empties into Cowichan harbour, and with the Koksilah river, which comes from the southwest, forms at its mouth an extensive mud flat. Chemainus river has also built up a broad, fertile, mud flat, over a mile wide, at its mouth.

GENERAL GEOLOGY.

The rocks of this area may be provisionally classified as follows:—

Superficial deposits	Pleistocene and Recent.
Cowichan group (Nanaimo, in part)	Cretaceous (in part).
Dike intrusions	Cretaceous (in part).
Saanich granodiorite	Upper Jurassic?
Mt. Sicker formation (Vancouver group)	Triassic-Jurassic.
Sansum formation	Triassic-Jurassic.

Mount Sicker Formation.—The Mount Sicker formation occupies a belt lying north of Cowichan harbour, which, at Sansum harbour, is 5 miles wide. Westward it underlies Maple mountain, Mount Richards, Mount Sicker, and Mount Brenton. At the foot of Mount Sicker the belt narrows to less than a mile in width, but to the west broadens out again. On Saltspring island it underlies a portion of the central part, but is intruded, and replaced in part, by granodiorite. Interfolded with the Sansum shales, it underlies the southern third of the island.

The Mount Sicker formation consists of dacites, augite-andesites, and andesite-porphyries, extensively altered to chloritic, quartzose, and talcose schists. Rounded, yellowish-green nodules of epidote are very common in these schists, giving them a 'knotted' appearance. A group of basic porphyritic rocks belonging to diorite and gabbro-diorite types, has been intruded into the series. Some are intrusive along the planes of schistosity, while others cut across these planes.

The formation has been intensely metamorphosed and closely folded along axes having a general strike N 70° W. Dynamic and thermal metamorphism has altered the rocks to schists. In this belt more or less mineralization has taken place, and in it the well-known copper deposits of Mount Sicker occur.

As no fossils have yet been found in the Mount Sicker rocks, it is difficult to say definitely to what age they belong. Since there is an undoubted unconformity between at least the higher divisions of the Cowichan group and the Mount Sicker formation; and since the upper part of the Cowichan group as seen on Saltspring island, apparently belongs to the Nanaimo group (upper Cretaceous), it is evident that the Mount Sicker formation is older than upper Cretaceous. The Mount Sicker formation is cut by the Saanich granodiorite, which has been correlated with the Coast Range batholith of upper Jurassic age; it is, therefore, probable that the Mount Sicker rocks are Jurassic or Triassic in age, and that they are one of the series that comprise the Vancouver group as defined by Dawson, and limited by Clapp.

Sansum Formation.—To the south of the schistose rocks of the Mount Sicker formation, shales occur, more or less metamorphosed and with interbedded argillites, tufaceous rocks, and sheets of andesite and dacite. Toward the south the shales are unaltered, and to these unaltered beds the name, Sansum formation, has been given; while those which are interbedded with the volcanic rocks have been grouped, provisionally, with the Mount Sicker formation. Where the shales are interbedded with the tufaceous rocks the contact is indistinct, but there is no doubt that the two types merge into one another. The unmetamorphosed shales are soft, black, and very fine in texture, with a peculiar concretionary form of weathering in certain beds. This type of weathering is also characteristic of many of the shales of the Cowichan series. Pyrite is common in the shales, and numerous impregnations are frequently found arranged parallel to the bedding planes.

Field evidence seems to show that the shales and tuffs underlie and grade upwards into the greenstones. This would make the greenstones younger than the shales and tuffs, contrary to the results obtained by Clapp[1] on the Chemainus river. Before the relative ages of the two groups can be definitely decided, it will be necessary to examine more closely the areas to the north of Mount Sicker, and along Chemainus river. Bands of graphitic schists and sandstone are found toward the southern part of the area occupied by the series, also conglomerates containing well rounded pebbles of fine-grained sediments and volcanic material which may have come from the Victoria group.

Saanich Granodiorite.—Intrusive into the Mount Sicker and Sansum formations is an irregular mass of granodiorite, called the Saanich granodiorite. This rock varies from a quartz-rich granodiorite to a diorite. On Saltspring island there are approximately 20 square miles of the granodiorite exposed. This batholith forms

[1] Clapp, H. C., Geol. Survey, Canada, Summary Report, 1908, p. 56.

a contact breccia with the Mount Sicker rocks on Saltpsring island; and at Ladysmith apophyses of the granodiorite were found cutting the older chlorite and amphibole schists. The extent of the granodiorite was not determined about Ladysmith. This granodiorite batholith may be correlated, provisionally at least, with the Coast Range batholith of upper Jurassic age.

Dike Intrusions.—Dikes are not numerous in this district; a few trap and andesite dikes, none more than 3 feet wide, cut the intrusive granodiorite and the older rocks.

Cowichan Group.—The Cowichan group, as defined by Clapp,[1] is made up of those conglomerates, sandstones, and shales which cannot be definitely assigned to the Sansum formation. The group consists of at least two unconformable series, and perhaps three. The lower division, which is exposed in this area, undoubtedly belongs to the Nanaimo group, as defined by Dawson,[2] and as mapped by Richardson.[3] On Saltspring island these rocks are found to the north of Burgoyne bay; while to the west, on Vancouver island, they underlie the Cowichan valley, and at Mount Prevost are overlain unconformably by sediments apparently belonging to the Upper division of the Cowichan group, or else belonging to the lower, and their present position is due to overthrust faulting.

The succession of this lower division of the Cowichan group is, in ascending order, conglomerate, sandstone, and shale. To the north of Cowichan harbour the sediments strike N 45° to 55° W, and dip 10° to 20° N. The dip increases northward, and at Maple bay it is about 70° N; the shales are here faulted off against the Mount Sicker rocks. In this locality the conglomerates are distinctly unconformable upon the Sansum shales and the Mount Sicker formations, which are dipping steeply. No evidence of extensive overthrusting is visible, and the conglomerate at the base contains very large boulders of the underlying volcanics, fragments of the metamorphosed shales, and occasional boulders of Saanich granodiorite.

On Saltspring island the same succession is found; Mount Baynes is capped by 700 feet of conglomerate lying unconformably upon the granodiorite, and made up almost entirely of boulders and well-rounded pebbles of granodiorite, granite, and quartz. The conglomerate dips slightly to the north, and is seen to fill up the depressions of the old erosion surface of the granodiorite. The same is seen at Beaver point, on the east of the island, where the conglomerate is in contact with the underlying greenstones of the Mount Sicker formation. Continuing northward, Mount Erskine and Mount Belcher consist of conglomerates interbedded with sandstones, and dipping 25° to 35° northeast. To the north the sandstones and shales have been folded into a syncline, or several small ones, underlying the depression between Ganges harbour and Vesuvius bay (Booth bay). Beyond this the series again have a northerly dip.

Superficial Deposits.—The greater part of the area is deeply covered with glacial detritus. There are also occasional Pleistocene and recent alluvial deposits. Some of these along the present shore-line are at least 100 feet deep; the upper beds in some places consisting of fine sand. The wave action is rapidly washing away these recent deposits, and as a result the shore is lined with out-fallen trees. Extensive alluvial flats are found at the mouth of the Chemainus and also of Cowichan river.

STRUCTURAL GEOLOGY.

The rocks of the Sansum and Mount Sicker formations are tightly folded, and in several places faulted. The axes of folding have a strike of N 35° to 75° W, with a general direction of N 60° to 70° W. In general, the dip is toward the south. Fold-

1 Clapp, C. H., Geol. Survey, Canada, Summary Report, 1909.
2 Amer. Jour. of Sci., 3rd Series, Vol. 39, p. 180, 1890.
3 Geol. Surv., Canada, Annual Report, 1876-7, p. 170.

ing is especially well seen on the southwest shore of Saltspring island, south of Burgoyne bay. Three distinct synclines there occur in a distance of about 4 miles. These synclines are composed of many smaller folds and contortions.

All the formations in the area have been broken by a series of faults which correspond to the general axes of folding. Particularly conspicuous is one cutting across Saltspring island between Fulford harbour and Burgoyne bay. On the north side of this fault the granodiorite occurs to an elevation of 1,300 feet, and is capped by 700 feet of Cowichan conglomerate, so that the displacement here has been very great. This break continues across Sansum narrows to Maple bay, and forms the contact between the Mount Sicker formation and the Cowichan group. Another parallel fault plane forms an escarpment in the central part of Saltspring island, to the north of Cusheon lake, and on which Mount Erskine and Mount Belcher are situated. This fault line may be connected with one running from Horseshoe bay to the mouth of Chemainus river. Another fault plane, parallel with these two, is exposed at the northeastern end of Cowichan harbour, and is probably the cause of the escarpment on the southwest side of Mount Tzouhalem, and possibly of the Cowichan harbour. Faults of smaller magnitudes are also numerous.

ECONOMIC GEOLOGY.

Copper and Iron.

In this district mineralized zones of shearing lie in highly metamorphosed igneous rocks of the Mount Sicker formation. Most of the more important deposits are of value on account of their copper contents; but in some cases magnetite is the valuable mineral, while many of the sheared zones are highly impregnated with well-crystallized pyrite.

On Mount Richards considerable mineralization has taken place. The ore consists of chalcopyrite, pyrite, and some sphalerite; bornite occurs very sparingly, and copper glance is reported. The gangue minerals are largely quartz with some barytes. Quartz alone sometimes occurs as veins in the sheared rock. The conditions here are similar to those on Mount Sicker. The ore deposits are intimately connected with the gabbro-diorite-porphyry and with the metamorphosed volcanics. The nature of the alteration of the country rocks suggests that the minerals, in some cases at least, have been brought in by heated solutions.

A large area—about 2 square miles—of diorite-porphyry, on Mount Richards, to the north of the Lenora railway, contains finely disseminated particles of chalcopyrite (and probably some chalcocite), to such an extent that, in almost any part of the mass, it is said to assay as high as one per cent in copper. The sulphides have also become segregated out along certain sheared zones. No work is being carried on at present, and the development to date consists of a number of small prospect holes. The most work has been done on the Iron Clad, Ureka, Lord Roberts, and Jena mineral claims.

The Iron Clad seems quite promising, but sufficient development has not yet been done to warrant a definite conclusion. The deposits are necessarily low grade; but it might be suggested that further prospecting along the contacts is advisable—especially between the more basic diorite and the sheared rocks. The rock along the sheared zones is sometimes quite talcose, and in one of the shafts, at the 30 ft. level, a 3 ft. vein of talc is said to have been exposed.

On the northwest slope of Mount Sullivan, on Saltspring island, magnetite occurs in a sheared zone in highly schistose rock. The zone is about 100 feet wide, and is filled with very finely crystalline jasper, giving the rock a reddish appearance. The iron ore is found chiefly toward the centre of the zone, and generally in narrow bands of almost pure magnetite; the widest one noted was 3 inches broad. The magnetite also occurs in irregular lenses surrounded by microcrystalline quartz.

Some of the magnetite has changed to hematite. The zone contains fragments of the sheared rock in it, and numerous, minute seamlets of quartz, while sulphides are absent.

Non-metallic Deposits.

A brief note is sufficient on the non-metallic deposits in this area. A small plant at Somenos is manufacturing common brick from the deep clay deposits which extend from Mount Sicker to Cowichan river. The alluvial deposits along the shore would doubtless furnish material for good, common brick, tile, and a cheap grade of stoneware.

The sandstone to the south of Vesuvius bay was the material used in the construction of the dry docks at Victoria. It is a light-grey variety, and readily weathers to brown. It varies in texture from fine to very coarse. The beds are thick and massive, and are situated on the shore of the bay, so that the rock can be quarried at small expense.

TOPOGRAPHIC WORK ON VANCOUVER ISLAND.

(R. H. Chapman.)

Field work in connexion with the preparation of a topographic map of Vancouver island began early in June, and continued with little delay until November. Topographic maps were completed over the region adjacent to the city of Victoria, the whole of the Saanich peninsula, a small part of Saltspring island, and many of the smaller nearby islands, comprising a total area of 150 square miles. Triangulation, level lines, and road surveys were made in an area adjacent to Nanaimo, in the direction of Ladysmith, but the topography was not finished, as bad weather set in and field operations were discontinued.

At first, one large party was organized, which operated in the vicinity of Victoria, but as the season advanced this party was divided until there were three, and finally four, parties working in widely-separated localities.

It was necessary to begin by obtaining a number of points to which the elevations and positions on the maps could be referred. This was done by extending triangulation control from points on hills near Victoria which had been located many years ago, and by level lines, run with engineers' level, starting from a bench-mark near the old Custom House in Victoria.

The triangulation was carried about 90 miles up the island, and furnished more than thirty points, including signals placed on mountain peaks, buildings, church spires, etc., all of which were used in connexion with the topographic mapping, or are available for future extension of it. Permanent marks were left on all points where observations were made, in order that they may be useful in extending this work or to local engineers and surveyors. About 45 miles of levels were run and checked by re-running, thus assuring good elevations and affording numerous points, by which the map work was controlled. More than thirty-five of these are permanently marked for utilization in local engineering and surveying problems. The elevations are dependent upon a bench-mark in Victoria which was referred to mean sea-level by data obtained from the Tidal Survey of the Department of Marine and Fisheries.

The mapping was carried on by what is known as the plane-table method. This combines a graphic triangulation giving many hundred locations, and the running of lines with the plane-table and stadia rod. It requires the topographer to complete the pencil drawing of the map in the field—with the country under survey actually before him—and leaves only the finishing, the inking and lettering, to be done at the end of the season, which necessitates a large field force that is not required in the office. Field maps were drawn at a fractional scale of 1:48,000, about an inch and one-third to a mile, which is slightly larger than the scale of final publication, and topographic features are shown by contours at an interval of 20 feet.

The following men rendered efficient services as assistants: K. G. Chipman, S. C. McLean, G. H. Burbidge, T. B. Williams, Oscar Barrette, T. A. McElhanney, F. S. Falconer, and J. D. Galloway.

Much valuable data was furnished by the Surveyor General of British Columbia, the City Engineer of Victoria, and by the officers of the Militia Department stationed at Victoria.

TULAMEEN DISTRICT, BRITISH COLUMBIA.

(Charles Camsell.)

INTRODUCTION.

General Statement.

The greater part of the field season of 1909 was spent in the Tulameen district in southern British Columbia. After a short time spent at Hedley obtaining some supplementary information for the Hedley report, the Tulameen district was reached June 29, and work was carried on there until the beginning of October.

In the summer of 1908 topographical mapping of this district had been begun by Mr. L. Reinecke, and by August of this year the field work had been finished. The completed map will cover an area of about 160 square miles.

The geological work on this area proved to be of exceptional interest from a scientific point of view; while the number and variety of metals, as well as coal, found within its limits, makes it a distinctly important one to the mining industry. For these reasons more time was required to do justice to the district than was at the disposal of the party, and about one-third of it yet remains to be examined.

Efficient aid was rendered in the geological work by the two assistants appointed: W. J. Wright and W. Agassiz. Acknowledgments are also due to many of the prospectors and residents of the district for information, and other assistance given.

Location and History.

The Tulameen district forms a part of the Similkameen Mining division of British Columbia, and is in the Yale district. The southern border of the sheet mapped is about 30 miles north of the International Boundary line; while the western border is about 19 miles east of the Fraser river, at the town of Yale. The area forms a rectangle, the sides of which are approximately 12 miles, by 13 miles; and it embraces within its limits the gold and platinum placers of Tulameen river and its tributaries; the gold, silver, and copper deposits of Bear, Boulder, and Slate creeks; and the coal basin of Collins gulch and Granite creek.

The history of the district prior to 1885 is obscure. Traces of old placer mining operations, which might be referred to the early gold excitement in the lower Similkameen in the sixties, are said to have been found by the placer miners in 1885 and later. Apart from this, however, the region was known only to the voyageurs of the Hudson's Bay Company, and other travellers, who used the old trail running through the middle of the district from Hope to Nicola.

In 1885 the district first came into prominence by the discovery of placer gold on Granite creek. The discovery is said to have been made by John Chance, a cowboy, who, in August, 1885, while riding up the bed of the creek in search of a lost horse, stooped to get a drink, and saw a nugget of coarse gold glistening on the bed-rock. The fact was soon advertised, but the season was then too far advanced for much work to be done. In the following spring, however, there was a large influx of miners into the region, and the greater part of the productive area on Tulameen river and its tributaries was staked out in mineral claims. The village of Granite Creek, which now has only a score of inhabitants, boasted a population of several hundreds; while Tulameen, 12 miles higher up the river, had twice as many. The high tide of production was reached in the year 1886, when gold to the amount of $193,000 was washed out of the gravels, principally on Granite creek.

Since 1887 the district has gradually been on the wane as far as placer mining is concerned, and at the present time only about a dozen men are actively engaged in this class of mining. Several attempts have been made to operate on a large scale by hydraulicking; but either from lack of experience in the operators, or from some other cause, they were not successful. These attempts have merely served the purpose of discouraging the investment of capital in a region which otherwise offers some good inducements for placer mining either by dredging or hydraulicking.

About the years 1898 and 1899 another class of miners began to enter and overrun the country, in the search for the original sources of the rich gold and platinum placers. High grade gold quartz veins were soon discovered in the Granite Creek basin, and in 1899 the gold copper ores of Boulder creek were staked out. In 1900 the properties on the Bear Creek basin, known as Law's Camp, were located, and in 1901 the copper ores of Independence camp, on the head of Bear creek, were discovered. Since then, in every year, some new mineral claims have been staked in various parts of the district, and some of the prospectors have maintained a continuous search for platinum in the solid rock. This search has not as yet been successful, and it is exceedingly doubtful whether sufficient platinum will ever be found in the rock to make it worth the cost of extraction.

For many years coal has been known to exist on Collins gulch; but the date of its discovery could not be learned. Four years ago the outcropping edges of the same seams were discovered on the North Fork of Granite creek, and on these outcrops a great deal of work has been done.

Little is at present being done in either placer or lode mining, but there is evidence that with the advent of the Victoria, Vancouver, and Eastern railway, the various companies owning properties in the district will commence operations.

Previous work.—The Tulameen district, though important, has not had much attention paid to it previous to the work of this year. Dr. G. M. Dawson paid a hurried visit to the district in 1888, and his observations are recorded in the Summary Report for that year.[1] In 1900, Prof. J. F. Kemp spent nearly three months in the district, investigating the geology of the platinum along the Tulameen river.[2] Mr. W. F. Robertson, provincial mineralogist for British Columbia, made certain observations on its ore deposits, based on a trip through the district in 1901.[3] In 1906 and 1908, the writer spent a few days at the close of the season examining certain of the mineral claims which showed the most promise of developing into mines, and a few notes on these are recorded in the Summary Report of the years indicated.[4]

GENERAL CHARACTER OF THE DISTRICT.

The district undergoing examination has partly the topographical features of the Interior Plateau region and partly those of the more rugged bordering mountain ranges. The east and northeast portions of the region have the lowest average elevation, and in this direction the upper levels slope gradually away to the general level of the central plateau of British Columbia. To the south and west the elevations increase. Although the topography in this direction is not that of a typical mountain range, the vertical relief is much greater, and in a few miles the divide between the Fraser and Columbia River drainage systems is reached. This divide is formed by the northern extension of the Cascade range, locally known as the Hope mountains. Followed southward to the International Boundary line, the Hope mountains broaden and divide into the Hozameen and Skagit ranges, which are separated by the deep

[1] Geol. Surv. Summary Report, Vol. 3, Part I, p. 62 A.

[2] U. S. Geol. Surv., Bull. 193.

[3] Report, Minister of Mines, B.C., 1901.

[4] Geol. Surv. Summary Reports, 1907 and 1908.

north and south valley of Skagit river. Continuing northward these mountains follow the trend of the Fraser river, and gradually decrease in elevation until they die away in the plateau region to the north of Thompson river.

The highest elevations in the district are in the southwest, where Lodestone mountain attains an elevation of about 6,100 feet above sea-level. From this side there is a general slope toward the northeast, where the highest points are almost 1,000 feet lower. Looking over this region toward the east from any one of the higher points, the summits are seen to be gently rounded, and of such a uniform level as to give an almost horizontal sky-line. Little indication is conveyed from this viewpoint, of the deep valleys by which the country is dissected. The lowest point in the map is the Tulameen valley, at the mouth of Granite creek, and the difference in elevation between this and the highest point gives a vertical relief of about 3,800 feet. The higher slopes are as a rule easy, but in the lower levels the hillsides are so steep that zig-zag trails are necessary in ascending them.

The whole area lies within the drainage basin of the Tulameen river. This stream rises in the mountains to the southwest of the area, and flowing easterly through the middle of it, passes out, and about 10 miles beyond joins the Similkameen river at the town of Princeton. These waters then find their way down the Okanagan river, and thence by the Columbia river to the sea. The most important tributaries joining the Tulameen are Granite creek on the south, and Otter creek on the north. Other branches—which are important from the fact that they hold rich gold and platinum placers—are Bear, Slate, Champion, Boulder, and Cedar creeks.

Below the mouth of Otter creek the Tulameen river occupies a broad, U-shaped valley, and has a comparatively easy gradient of about 30 feet to the mile. This type of valley is continued up Otter creek to the north, with a still lower gradient, so much so that several lakes have formed, the most important of which is Otter lake, over 3 miles in length. Above the mouth of Otter creek the broad valley on the Tulameen continues for 3½ miles. Beyond this there is an abrupt change in shape, and an accompanying steepening of the gradient. Here the river occupies a narrow rock-walled cañon cut for several hundred feet into the bed of a much broader valley lying above it. This suggests a very recent uplift, at least post-glacial, of this portion of the district.

All the streams tributary to both the Tulameen river and Otter creek have relatively easy grades in their upper portions, but enter the main valleys either by a series of steep falls or through narrow V-shaped cañons. They are, therefore, hanging valleys. The most typical of these are the valleys of Slate and of Elliot creeks.

Virtually the whole of the area is heavily wooded. Parts of it are park-like in appearance, and similar to the Nicola or Kamloops districts; but only in the higher tracts, above the 6,000 ft. level, is there much open, grassy country.

The climate is considerably more moist than in the country farther east in the Similkameen valley; and while the summer temperature does not rise as high, the winters are much more severe. Except in the Tulameen and Otter valleys, there is no land that is free enough from summer frosts to be entirely suitable for agricultural purposes, and even in these valleys only the hardier vegetables are successfully grown. Apart from the very few persons who have homesteads in these valleys, the whole population is, directly or indirectly, engaged in mining pursuits.

Communication with the outside world is at present maintained by means of a wagon road running through the northern and eastern portions of the district between the Canadian Pacific railway at Nicola and the Great Northern railway at Princeton. Surveys have, however, been made by the Great Northern Railway Company for a line through the district, which, when built, will bring it within a few hours' run of Vancouver.

GENERAL GEOLOGY.

Owing to the fact that only a portion of the area outlined in the forthcoming topographical map was geologically examined, it is impossible to give a complete table of the different formations that occur within it. The following table, therefore, is provisional, and merely covers the portion of the country examined:—

TABLE OF FORMATIONS.

Quaternary	Stream deposits. Glacial deposits.
Post-Oligocene	Otter granite. Volcanic rocks.
Oligocene	Sandstone, shale, and coal. Volcanic rocks.
Pre-Oligocene to post-Triassic	Augite syenite. Pyroxenite. Peridotite. Boulder granite. Eagle granite.
Triassic	Volcanic rocks with some argillites and limestones.

Triassic.

Stratified rocks, provisionally referred to this age, are the oldest rocks in the district. They still cover a wide area, though considerably diminished by later intrusions of eruptive rocks. North of the Tulameen river they cover the greater part of Bear Creek basin, and pass over the divide eastward toward Otter valley. South of the Tulameen river they are found as a narrow strip in Champion Creek basin, between the Eagle granite and the pyroxenite. They occur again in Slate creek, but east of this are covered by rocks of Oligocene age.

A complete section of these rocks has not yet been worked out, partly because no top or bottom has been found, and partly because they have been so much cut up by later igneous intrusions that a complete section is nowhere visible. The partial section exposed in the cañon of Tulameen river between Champion and Bear creeks, shows at the top some bands of limestone interbedded with hornblende schists succeeded by great thicknesses of volcanic rocks in which some narrow bands of argillite and limestone are intercalated. The volcanic rocks are largely agglomerates and breccias, with andesite and diabase flows, the latter being metamorphosed to chloritic and other schists. The prevailing strike is roughly in a north and south direction, with dips varying from 20° to 90°. The rocks have passed through severe orogenic disturbances, and are traversed by many small quartz veins, some of which are highly mineralized. They are cut by all the intrusive rocks of the region, and by all the dikes.

No fossils were found in the limestones, but in the argillites on Slate creek some plant remains were collected, which, however, are so badly preserved as to render identification impossible.

These rocks are referred to the Triassic, from their lithological similarity to rocks of the Nicola series in the Kamloops district, in which Triassic fossils were found by Dr. Dawson. Their structure is such that they must have been involved in much of the orogenic disturbances of Mesozoic times, and they may possibly be older than Triassic, but are certainly not younger. They represent a long period of volcanic activity, during which they were extruded and flowed over the surface. It is probable that part at least, if not all, of the series was deposited under water, and that the narrow bands of true sediments intercalated with them merely represent short periods of quiescence.

Pre-Oligocene to Post-Triassic.

During the period between Triassic and Oligocene no fossil-bearing strata were deposited in this area, hence it is presumed that this was a period of continuous erosion. During this time, however, the region was not undisturbed, and its geological history is recorded in the intrusions of several large bodies of igneous rock. The sedimentation and accompanying vulcanism of Triassic times was brought to a close by the Jurassic revolution of the western part of the Cordillera when these rocks were uplifted and considerably disturbed. Immediately following this disturbance, and perhaps in consequence of it, batholithic intrusion began. The relative ages of the intrusions have not yet been all worked out, and, therefore, the positions assigned them in the table of formations are provisional only.

Eagle Granite.—This granite occupies the whole of the western border of the area from north to south, and has also been traced some distance to the south of it, so that it has a length of at least 15 miles. To the west, the granite passes outside the limits of the map, but it appears to have an average width of about 5 miles.

The Eagle granite is coarse-grained, gneissic in structure, and very uniform in composition. Its constituents are quartz, white feldspar, and biotite. It is traversed by many small quartz stringers and by coarse pegmatite dikes. The gneissic structure has in general a north and south alignment parallel to the general trend of its longer contacts.

On its eastern border the Eagle granite is in contact with the Triassic stratified rocks. It sends off many apophyses into these, and has effected in them a great deal of contact metamorphism; it is, therefore, clearly post-Triassic in age. Outside the limits of the map, to the southwest, is a belt of Cretaceous rocks with conglomerates at the base which contain boulders of this granite, making the age of its intrusion pre-Cretaceous. It is, therefore, approximately contemporaneous with the intrusion of the Coast Range batholith.

Boulder Granite.—The area of this granite has not yet been completely outlined; but enough has been mapped to show that it is an important item in the geology of the area. It is found on the west side of Otter valley, running from Elliot creek down to the Tulameen river, while smaller bodies occur on Otter mountain and on Collins gulch. It is an acid, coarse-grained rock, composed of quartz, light coloured feldspar, and greenish hornblende. It has been much fractured and sheared, and often shows slickensided faces. Many of the fracture planes are filled with white quartz.

The relation of the Boulder granite to most of the other rocks is obscure. It is undoubtedly intrusive into the Triassic volcanic rocks, and on Boulder creek contains inclusions of these. It is not found in contact with the Eagle granite. It appears to be older than the augite syenite, for it is much more fractured and sheared, but contacts between the two are not exposed. The Oligocene rocks of Collins gulch, however, rest directly on the Boulder granite, and are younger than it.

Pyroxenite.—This rock is best developed in the region, from Lodestone mountain northward to Grasshopper ridge. It enters the area as a band about 2 miles wide at Lodestone mountain, and running northerly from there to Olivine mountain, splits at that point, and continues on across Tulameen river as two narrow bands enclosing an area of peridotite. Small isolated areas of pyroxenite are found at the forks of Bear creek, and on Henning mountain at the head of Bear creek.

Normally, the pyroxenite is a coarse-grained, black, glistening rock, composed almost entirely of black pyroxene and magnetite. At times the pyroxene is dark green in colour and has some feldspar with it. Near the border of the peridotite, olivine becomes an abundant constituent, and many of the pyroxene crystals are of great size. Hornblende is nearly always present, either as an original mineral or as an alteration of the pyroxene.

In age, the pyroxenite is certainly older than the augite syenite. Its relation to the peridotite, however, is peculiar. Prof. J. F. Kemp, as well as the writer, has found dikes of pyroxenite cutting the peridotite;[1] while the writer had undoubted evidence of a dike of peridotite in pyroxenite. Generally, however, the contact between these two rocks is a transitional one, and it seems likely that they are merely differentiation products from the same magma. Several dikes of pyroxenite were found cutting the Triassic rocks.

Peridotite.—The peridotite forms an elongated body, about 3 miles long and a mile wide, extending from the summit of Olivine mountain across Tulameen river to Grasshopper ridge. It is surrounded by pyroxenite on all sides except the north, and there it is covered by drift. A small dike is also found on the northeast side of Lodestone mountain.

The peridotite consists essentially of olivine, with occasional grains of chromite. It is, therefore, the variety dunite. It is dark green in colour, sometimes dense black. It alters readily on the surface to serpentine, and is traversed by a great many small veins of this material. It is very resistant to weathering, and forms one of the highest hills in the district. The outcrop has a typical dun colour, and the rock often weathers in spheroidal shape. It is not found in contact with any other rock except pyroxenite, and this contact, as already described, is generally a transitional one. The relative age, therefore, assigned to the pyroxenite, would apply to the peridotite.

Augite Syenite.—This rock has a considerable distribution in the southern portion of the area on the heads of Slate creek, and some of the western branches of Granite creek. How great an area it covers in this direction is not yet known, for it passes outside the limits of the sheet. The part examined indicates that it has the proportions of a stock of very irregular outline. Dikes and small irregular bodies of similar rock are found to the north of the Tulameen river at Otter lake, and in the basin of Bear creek.

The augite syenite shows considerable variation both in composition and texture. The most common phase is a rock of granitic texture, composed of white feldspar and black pyroxene. Black hornblende is a very common constituent, but is, probably, generally of secondary origin. The feldspars are mostly orthoclase. No quartz is present. In structure it is massive, but it has been somewhat sheared in a north and south direction. Along its contact with the older volcanic rocks it shows an incipient schistose structure.

On Granite creek it underlies the Oligocene volcanic rocks, and is undoubtedly older than these. On the other hand it is intrusive into the volcanic rocks, which are referred to Triassic age. Dikes of augite syenite are also found cutting the boulder granite; while the contact with pyroxenite shows inclusions of pyroxenite in the augite syenite.

Oligocene.

The period of Oligocene sedimentation was inaugurated by a down-warping of the surface, and in the down-warped area volcanic rocks were first extruded. This was followed by a long period of stable conditions, during which true sediments and coal beds were laid down.

Rocks of Oligocene age cover a considerable area in the southeast portion of the district, in the angle between Tulameen river and Granite creek. Small portions of the series are found on the north side of Tulameen river, on both sides of Otter lake. Southward, in the basin of Granite creek, their extent has not been defined. These rocks have been divided into two series: a lower, which is almost wholly volcanic in origin; and an upper, which is sedimentary and coal-bearing.

[1] Bull. U.S. Geol. Surv., No. 193.

In composition the rocks of the lower series are basaltic, but become more andesitic toward the top. A small band of conglomerate and sandstone is intercalated with them, and outcrops on the northern face of Jackson mountain, also on Blair creek north of Tulameen river. The volcanic rocks are dark coloured and massive toward the base, but very shaly toward the top. They dip at low angles toward the south, and do not appear to have suffered much disturbance.

The upper series of Oligocene rocks is sedimentary, and contains all the Coal Measures. It covers about 8 square miles, and is found in the basin of Collins gulch, and passes over the divide into the Granite Creek slope. The rocks of this series have not yet been thoroughly examined, but are known to consist of sandstones and shales, with beds of coal. The sandstones are sometimes so coarse as to become conglomerates. The finer grained sandstones contain many plant remains. The shales are very thin-bedded, and they also carry a great many plant remains, which have been identified as mostly Oligocene forms. Four different coal horizons have been determined, and there are, possibly, one or two more. These rocks dip at angles varying from 20° to 40°, and generally toward the centre of the area covered by them. In Collins gulch they have been considerably disturbed, but where elsewhere examined they appear to have a regular dip.

A collection of over forty specimens of fossils was made from two localities; one on Collins gulch, and the other on Granite creek. These have been examined by Mr. W. J. Wilson, of the Geological Survey, who has identified six species of plants. These are: *Comptonia diforme, Taxodium distichum miocenum, Sequoia langsdorfii, Sequoia angustifolia, Sequoia heerii,* and *Sequoia brevifolia.* Four out of the six species are restricted to Oligocene rocks, while the other two range from Cretaceous to Miocene.

Therefore, the rocks are Oligocene in age, and correlated with similar coal-bearing rocks at Princeton, Nicola, Kamloops, and other places in the southern interior of British Columbia.

Post-Oligocene.

Volcanic Rocks.—Volcanic rocks which appear to rest unconformably on the fossiliferous Oligocene have a limited distribution on the divide between Granite creek and Collins gulch. They are not of great thickness, and are basaltic in character. They are dense black in colour, and finely crystalline, while in texture they are amygdaloidal, and in structure massive. They have an irregular or conchoidal fracture, and weather to a dull reddish colour. They have not been disturbed, and are quite fresh in appearance, exhibiting a strongly-marked columnar structure.

Otter Granite.—A pink granite—which for convenience in differentiating it from earlier granites has been called the Otter granite—is found on the west side of Otter valley, at the northern end of Otter lake. The distribution of this granite has not yet been outlined, but its western contact has been defined for a distance of about 7 miles. It consists of pink and white feldspar, some dark hornblende, and a little glassy quartz. In places the quartz is so sparingly present that the rock almost becomes a syenite. It is quite fresh in appearance, is unsheared, and forms bold outstanding cliffs. Its relation to the post-Oligocene volcanics is unknown, but apophyses from it cut the volcanic rocks which form the lower half of the Oligocene series, so that its age is post-Oligocene.

Quaternary.

As the whole area under discussion was covered by ice during part, at least, of the Glacial Period, glacial deposits are widespread. These consist of erratics, unassorted boulder clay, and some stratified clays. The boulder clays are the most important. At Slate creek, stream deposits were noticed between beds of boulder clay, which might indicate an interglacial period. Stratified clays on Bear creek,

associated with glacial and later stream deposits, are probably of glacial origin, and due to deposition in a glacial lake formed by the damming of the outlet of this stream to the Tulameen river.

The stream deposits are important from an economic point of view, for in them were found the gold and platinum placers which first brought the country into notice. These deposits are found in the valleys of all the streams. On the Tulameen river a complex series of terraces line the slopes of the valley up to a height of about 400 feet above the present bed of the stream. The terraces are not continuous along the valley, but are merely remnants of older, more extensive stream deposits, which have not been washed away by later river erosion. In certain places, for example, at the mouths of Slate, Cedar, and Champion creeks, they no doubt represent old channels of these streams which have since been abandoned.

Dikes.

Besides the larger rock bodies above described, there is a great variety of dike rocks. Those identified in the field are rhyolites, granite porphyries, syenite porphyries, andesites, and diabases. The relative ages of these have yet to be determined.

ECONOMIC GEOLOGY.

Considering the size of the Tulameen district, it is remarkable what a variety of deposits of economic importance are found within its limits. Not all of these deposits, however, have as yet been exploited, or even prospected. The following list contains all those known to have any present or prospective value:—

Gold and platinum placers.
Gold quartz veins.
Copper and gold-copper deposits.
Silver and silver-lead deposits.
Magnetite deposits.
Chromite deposits.
Molybdenite deposits.
Asbestos.
Coal.

Gold and Platinum Placers.

The placers of the Tulameen district have, up to date, proved to be the most important of its ore deposits. Since 1885 they have been worked more or less continuously, but the output has gradually decreased and is now very small. The most important localities in which payable placers were found are Granite creek and its tributaries, Collins gulch, Cedar, Slate, Bear, and Boulder creeks, and the Tulameen river below the mouth of Champion creek. All of these streams yielded coarse gold, and in nearly all of them platinum was found with the gold. Other minerals found in association with these in the black sands, were native copper and silver glance.

While the largest gold nugget found in the district—said to have been worth $320—came from the gravels of Bear creek, the greatest amount of coarse gold was taken from Granite creek, where nuggets weighing from 5 to 8 ounces were frequently found. The Tulameen river was the richest in platinum, and the largest nuggets of this came from the portion of the river between Bear and Champion creeks. The proportion of gold to platinum on the different creeks varied. On Granite creek, estimates by some of the early miners give from 2 to 4 parts of gold to 1 of platinum, while on the Tulameen river between Bear and Champion creeks the proportion is given as about 1 to 1.

Platinum nuggets weighing, possibly, half an ounce, are now in the possession of Mr. Cook, of Granite creek. Samples taken last summer from the bed of Granite creek were found to consist of two kinds of grains: one magnetic, the other non-magnetic. The magnetic grains were covered with small adhering particles of magnetite, while the non-magnetic grains were quite clean. All of the grains were pitted with small holes, and some of them had small particles of the country rock still adhering to them. An analysis of nuggets from these placers made by Mr. G. C. Hoffmann,[1] gave 78·43 per cent of platinum for the magnetic portion, and 68·19 per cent for the non-magnetic. The remainder of the sample was made up of iron, copper, and the platinum metals iridium, osmium, palladium, ruthenium, and rhodium.

The source of the gold has not yet been definitely settled, but from its coarseness and angularity it could not have been transported very far; and it is very probable that it was derived from small quartz veins which traverse the volcanic rocks of Triassic age. Prof. Kemp[2] has concluded that the platinum was derived from the peridotite and pyroxenite rocks lying in the basin of Slate creek and crossing the Tulameen river below Champion creek. In the opinion of the writer, no other source is possible.

In testing for platinum in these rocks, Prof. Kemp's best results were obtained from the peridotite, or from pyroxenite dikes in peridotite; and particularly where alteration had taken place to serpentine or where the rock was rich in chromite. No uniformity in the results, however, could be obtained, and often no platinum could be got where it was most expected.

With a view of getting additional information, samples were collected this summer, and were assayed for platinum by Mr. M. F. Conner, of the Mines Branch. One sample of peridotite, rich in chromite, gave 0·02 of an ounce of platinum to the ton of rock. Two samples of magnetite, from the pyroxenite of Olivine mountain, gave nothing. A sheared zone in pyroxenite containing some chalcopyrite, and a coarse pegmatitic dike of pyroxenite cutting pyroxenite, also gave nothing. The results obtained seem to show that of the two rocks, the peridotite is the more frequent host of the platinum, while the pyroxenite when it is distant from any body of peridotite contains none.

The value of the gold in the various creeks is fairly constant; the banks paying $17.80 for it. The gold from Boulder creek always brought a slightly higher price.

The total gold production of the Tulameen district up to 1908—as obtained from the reports of the Minister of Mines for British Columbia—is about $725,000. There is no doubt, however, that much gold was obtained from these creeks of which the British Columbia government got no returns. From the same source it was ascertained that the total value of the platinum produced was about $45,892. These figures convey no idea of the quantity of platinum produced; for the price paid for it in the early days, when the greatest amount was mined, was not more than $3.50 per ounce, and in the first year or two, only 50 cents. Mr. C. F. Law, who has been closely connected with mining operations in the Tulameen district for a number of years, has made an estimate of the total production of platinum from Tulameen river and tributary streams during the last twenty-four years, and he places the amount at about 20,000 ounces. Of this amount more than half is known to have passed through the hands of certain white men in the district, while the remainder is accredited to Chinamen, who of all placer miners have been the most persistent in their mining operations.

The price of platinum in recent years has fluctuated widely. In November, 1909, it stood at $29.50 for refined platinum, and $33.25 for the hard metal. The hard metal is that which is rich in iridium and osmium, these metals being allowed to remain alloyed in the platinum of the ingots. The platinum of the Tulameen district contains a sufficient percentage of both iridium and osmium to allow it to be classed as hard metal, and it, therefore, brings the higher price. Figures bearing on the average per-

1 Geol. Surv. of Canada, Vol. II, page 5 T.

2 Bull. U.S. Geol. Surv., No. 193.

centages of platinum, iridium, and osmium in the Tulameen product are not yet available for publication.

Although little placer mining is now being carried on, this is not due to the complete exhaustion of all the available ground. In the opinion of some of the best informed miners in the district, a great deal of ground yet remains in the valley of the Tulameen and its tributaries—particularly Granite creek—that would repay working. It is true this ground is what is called deep ground; but the chances of successfully exploiting deep ground are greater than formerly. Only the 3 miles of Granite creek below the mouth of the North Fork have been thoroughly worked; its tributaries above this are yet largely untouched. On Slate creek, also, and on the Tulameen itself, there are deep gravels and bench deposits, which no doubt could be profitably worked; but all of these require both capital, and intelligent, experienced mining.

On the main Granite creek, a short distance above the North Fork, R. A. Lambert has been working for the last three years. He has built a dam across the stream, from which 600 feet of flume carry the water over the creek bed below. Some 15 to 30 feet of the surface gravels from the bed of the stream have been ground-sluiced out to within a few feet of the actual bed-rock. This portion of the creek bed has not been previously worked, on account of the depth of the gravels, but good pay was obtained immediately above and below, and it is expected that this portion also will give reasonable profit. A company called the British Columbia Platinum Company, holding leases on Tulameen river and Slate creek, has been formed for the purpose of recovering the platinum from some of the deeper ground and benches on these streams.

Gold Quartz Veins.

On the eastern side of Granite creek, and on the divide between it and Ninemile creek, some very rich stringers of gold-bearing quartz cut the green schists. Two at least of these have been worked in a small way, and the gold recovered by crushing and mortaring. The gold, however, was not evenly distributed through the veins, but occurred in bunches; hence the work was not always profitable.

In the lower part of Granite creek and in Tulameen river directly below it, coarse nuggets of gold, found in the gravels, contained a great deal of white quartz, indicating that the gold was derived from quartz veins higher up the stream.

Copper and Gold Copper Deposits.

Deposits containing these metals are perhaps the most important in the district, and are certainly the most widespread; for the great majority of mineral claims are located on deposits of this nature. Some of these have been described in the Summary Reports for 1906 and 1908, and are here only briefly referred to.

The Independence group, at the head of Bear creek, is one of those previously described as having an ore body lying in a granite porphyry intrusive between the old Triassic schists and the gneissic Eagle granite. The ore body on this and adjacent claims is a replacement deposit of the butte type. Fissures have been formed in the granite porphyry, and the formation of ore has progressed along these fissures, passing outward from them into the country rock. Secondary enrichment by descending solutions, however, has not gone deep, and the ore body is simply the result of uprising solutions carrying sulphides. The sulphides present are chalcopyrite, pyrite, pyrrhotite, blende, and molybdenite with some tetrahedrite and chalcocite. The chalcocite is undoubtedly a secondary mineral formed by enrichment from chalcopyrite. The gangue of the ores is the altered country rock with some quartz and calcite. The surface ore is said to have given assays of about 20 per cent copper, but the ore on which the value of the deposits depends only averages about 3 per cent. There is also a small amount of gold present with the copper. The ore does not contain sufficient calcite to make it self-fluxing, and the combination of minerals is such that it may be difficult to concentrate.

Law's Camp, on the western slope of Bear creek, was also briefly described in the Summary Report for 1906. The camp embraces a number of claims located on the contact of the gneissic Eagle granite and the interbanded limestones and schists. The deposits are gold-copper replacement deposits of moderately deep-seated origin. The ore bodies occur in the limestone bands as lenses, which pinch and swell both vertically and horizontally. The replacing sulphides are pyrite, pyrrhotite, blende, and galena, and the values are in gold, silver, and copper. The limestone bands are generally narrow, and the schists often form the walls. They dip at from 30° to 60° to the west into the granite, and the ore often seeks the hanging-walls. The gangue is limestone which has not been entirely replaced by the sulphides.

There are in Law's Camp certain exceptions to the above class of deposits, in which the ore bodies are of contact metamorphic origin, connected with the granite or some of its apophyses. These are characterized by a development—along with some of the above-mentioned sulphides—of magnetite, and the formation of a gangue of the lime silicates, garnet, and epidote.

Other copper deposits on which work has been done are situated on Rabbit mountain and on the divide between Elliot and Boulder creeks. These are replacement deposits in Triassic schists, and are connected with intrusions of granite or granite porphyry. The sulphides are pyrite and chalcopyrite, which replace certain bands in the bedded rocks.

Other deposits in which the mineralization has been chiefly by chalcopyrite and which occupy shear zones in pyroxenite, occur on the western side of Slate creek and on the slope of Olivine mountain.

Silver and Silver-lead Deposits.

Dr. Dawson states that in the early placer mining operations in this district, pellets of pure silver glance strung through with gold were found in the washings on Tulameen river somewhere in the vicinity of the mouth of Eagle creek.[1] The occurrence of these suggests the presence of some remarkably rich deposits of silver ore somewhere in the region traversed by the Tulameen river or its tributaries.

In the bed of Champion creek, where dikes of granite are in contact with crystalline limestone, small veinlets of quartz containing pyrite, blende, and tetrahedrite, traverse both the limestone and the granite. From these veinlets, which are only a few inches wide, remarkably high assays in silver are reported to have been obtained. The silver is probably contained in the tetrahedrite in this case.

Argentiferous galena occurs in the replacement deposits of Law's Camp; but probably the most important occurrence of silver is in the galena of Summit Camp, at the head of Tulameen river, about 12 miles by trail beyond the area mapped. These deposits are apparently replacements by galena, blende, and pyrite, of limestones along zones traversed by lines of fissuring. The deposits appear to be of considerable importance, but are handicapped by being located at too great a distance from easy means of transport.

Magnetite Deposits.

Bordering peridotite on all sides, and extending from the Tulameen river southward to Lodestone mountain, is a large body of pyroxenite, which almost invariably carries a certain proportion of magnetite. At Coutney's cabin on Olivine mountain, on Lodestone mountain, and elsewhere, the magnetite in the pyroxenite increases to such an extent as to greatly affect the compass. It occurs as short irregular veins or large bunches in the pyroxenite, the whole having in general an east and west trend.

[1] Geol. Sur., Canada, Vol. III, p. 62 A.

These magnetite bodies are not connected with any system of fracturing, but are segregations formed, like the chromite in the peridotite, as differentiation products of a cooling magma.

Several claims were staked on the outcrops of these magnetite deposits years ago, but no development work has yet been done nor tests made.

Chromite Deposits.

Chromite occurs in varying quantities in the peridotite of Olivine mountain. It appears generally along certain east and west zones, where the peridotite has been most readily altered to serpentine, and occurs in short, irregular veins from half an inch to an inch in width, and in irregular masses or bunches in the dark green olivine. It also occurs in small disseminated crystals in the massive peridotite not connected with any fracturing or fissuring. It is doubtless a differentiation product of the peridotite magma in the process of cooling. In the experience of those working on this peridotite area, some of the best assays for platinum have been obtained from peridotite, very rich in chromite. This is in accord with the results obtained by Prof. Kemp in his study of the geology of the platinum.

Molybdenite Deposits.

Molybdenite is found sparingly, as disseminated crystals in granite porphyry, at Independence Camp on the head of Bear creek. On Champion creek, however, it occurs in considerable quantity, in altered limestone at the contact of gneissic granite. Being associated with garnet and epidote, it is presumably of contact metamorphic origin. It occurs in flakes and grains, associated with pyrite and a little blende in a gangue of reddish garnet, green epidote, and quartz. A few claims have been staked to cover the exposures of molybdenite, but, owing to the form in which it occurs, it is doubtful whether it can be successfully recovered.

Asbestos.

Numerous veins of asbestos traverse both the peridotite and the pyroxenite in the Tulameen valley. Although many of the small veins in the peridotite contain a good quality of fibre, the larger veins, and particularly those in pyroxenite, were found to be either too brittle or too talcy to be of commercial importance. But, since no systematic prospecting has been done, it is possible that deposits of commercial magnitude may yet be found.

Coal.

The occurrence of coal in the district was briefly referred to in the Summary Report for 1908. The coal has long been known, and recently an attempt has been made to prospect the basin and find out its extent.

The basin occupies only about 8 square miles of territory, all covered by coal claims. About fourteen claims have been staked and are being held, but only nine of these seem likely to contain coal in workable quantity.

The coal basin is almost circular, and is occupied by sandstones, shales, clays, and coal seams. These rest conformably on volcanic rocks consisting of agglomerates, basalts, and andesites, and are in part covered by more recent volcanic flows. The rocks have been tilted at low angles, and on the outer borders of the basin appear to dip toward the centre. The angles are never more than 45°, and are generally less. Small folds appear on Collins gulch, and in other places minor faults occur; but on the whole the disturbance is probably not great enough to seriously affect the mining of the coal.

The rocks have been determined from their fossils to be Oligocene in age, and in consequence they are correlated with the coal basins of Princeton, Nicola, Kamloops, and with other Tertiary lake basins of the interior of British Columbia.

The whole basin has not been thoroughly examined, hence it is impossible to say how many seams of coal it may contain. Four coal horizons are known, and it is possible that there may be one or two more. Three samples for analysis were taken from the workings on the Granite Creek side of the basin, and one from Collins gulch. The analyses of these are given below. No. 1 is from a seam 6′–6″ wide, taken from an upraise to the east in No. 2 tunnel on the Granite Creek workings. This seam is 17 feet above the floor of the tunnel, and the sample was taken across the face of the seam. No. 2 is from the 5 ft. seam on which No. 2 tunnel is driven, and the sample was taken right across the face. No. 3 is from a seam about 5 feet thick, in No. 4 tunnel, and was taken from the face of the tunnel, which is 168 feet long. No. 4 was taken from the outcrop of a seam of unknown width on Collins gulch. The analyses were made by Mr. F. G. Wait, of the Mines Branch:—

No. 1—

Moisture	3·04
Volatile combustible matter	31·88
Fixed carbon	51·11
Ash	13·97
	100·00
Coke, strong, coherent	65·08 per cent.
Fuel ratio	1:1·60

Colour of ash, light ash grey.

No. 2—

Moisture	4·34
Volatile combustible matter	31·08
Fixed carbon	48·89
Ash	15·69
	100·00
Coke, strong, compact	64·58 per cent.
Fuel ratio	1:1·57

Colour of ash, ash grey.

No. 3—

Moisture	2·97
Volatile combustible matter	31·28
Fixed carbon	52·49
Ash	13·26
	100·00
Coke, strong, compact	65·75 per cent.
Fuel ratio	1:1·68

Colour of ash, light ash grey.

No. 4—

Moisture	3·26
Volatile combustible matter	43·33
Fixed carbon	49·70
Ash	3·71
	100·00
Coke, tender, coherent	53·41 per cent.
Fuel ratio	1:1·15

The analyses of Nos. 1, 2, and 3 indicate a fairly high grade coal—one which ranks as bituminous. They resemble closely analyses of certain Virginia coals; and even compare favourably with some coals from the Pennsylvania coal field. The coals are also somewhat similar to those of the Nicola field. The majority of the coals of the interior of British Columbia, of this age, are sub-bituminous, or even lignitic; but the higher grade of the Tulameen coal is accounted for either by the greater pressure which it has undergone or by the presence of the volcanic rocks immediately overlying it, which by their heat may have driven off a certain percentage of the water.

The ash is high, because the samples were not picked, and in taking a section across the seam, small clay partings may have been included in the samples.

The coke of the three Granite Creek samples is strong and coherent, and has a bright silvery lustre. A test of a larger sample would be advisable; but from the information obtained from these samples it is evident that the coal will coke, and will give a product which no doubt can be used for smelting purposes.

The coal exposed on Granite creek is undoubtedly of better quality than that which outcrops on Collins gulch, though both are in the same basin; and while the latter will be of use for domestic purposes, the former is a better steam coal, and will be in demand by the railways which are projected through that district.

The development work on this coal basin has all been done on a group of claims recently sold to a company called the Columbia Coal and Coke Company, the members of which are: J. T. Johnston, J. E. Grey, D. Donald, W. L. Parrish, and J. W. Bettes. The work has largely been done on the Granite Creek side of the basin, and amounts to almost 1,000 feet of tunnelling and raises, and a large quantity of open-cuts and test pits. On Collins gulch three tunnels of unknown length have been driven, but these are now caving in.

In a hurried reconnaissance to the head of the Tulameen river, an area of Cretaceous rocks was encountered just above the mouth of the South Fork of that stream. These rocks are probably continuous with Cretaceous rocks which appear on the Skagit river and on the International Boundary line between the Roche and Pasayton rivers. Float coal is reported to have been found on the Roche river, and also on the Tulameen where these rocks cross. If this report is true, it is probable that the coal was derived from these Cretaceous rocks; for no other probable coal-bearing strata were found. No coal has, however, yet been found in place.

BEAVERDELL DISTRICT, WEST FORK OF KETTLE RIVER, BRITISH COLUMBIA.

(L. Reinecke.)

INTRODUCTION.

General Statement.

The first part of the season—from July 1 to August 25—was spent in finishing the field work for a topographical map of the Tulameen district, in southwestern British Columbia. The party then moved 80 miles to the east, to Beaverdell, on the West Fork of Kettle river. Work commenced here on September 3, and continued until November 12. In this district our time was occupied chiefly in making a topographic map. Rock specimens were collected for microscopic study in the winter, and four days were spent in an examination of the more important mines and prospects.

Messrs. S. I. Wookey, F. H. McCullough, and L. W. Berry—who acted as assistants—did very satisfactory work. Acknowledgments are due the mine owners and residents at Beaverdell for information and assistance.

Location.

Beaverdell is situated about 25 miles up West Fork, a branch of Kettle river, in southern British Columbia. It is about 45 miles from Midway, on the International Boundary.

The map when completed will include 20 minutes of longitude and 15 of latitude: that is, an area a little over 14 miles east and west, by 17 miles north and south. It extends from the West Fork, including the mouth of Carmi creek, and the junction of Wilkinson and Ferroux creeks (approximate longitude, 119° 9′), eastward to the valley of Kettle river. The southern boundary is south of the mouth of Cranberry creek on the West Fork (latitude, 49° 24′). The northern boundary passes about 2 miles beyond Arlington hill on the West Fork.

Within this area occur the silver-lead ores on Wallace mountain, and the gold-silver deposit at Carmi. In addition, silver and copper prospects have been opened in various parts of the area.

History.

Claims were first staked on Wallace mountain in 1889. They were allowed to lapse, however, and active prospecting was not begun until 1896. In that year and the following the more important claims on Wallace mountain were located. Between 1896 and 1900, prospecting was carried on all over the district. The Triple Lakes camp, just west of Kettle river, and the Arlington Hill—since practically abandoned—were then located and worked. Development work was begun on the Carmi mine in 1899; and on the Sally group, on Wallace mountain, in 1900. Mining on a small scale has been prosecuted on Wallace mountain from 1900 to the present date. The Sally group, and the Bounty Fraction, Rambler, and Buster properties, are now in active operation. The Carmi mine was worked between 1899 and 1900, and again in 1904. It has been shut down since then.

GENERAL CHARACTER OF THE DISTRICT.

Topography.

The area examined lies entirely within the Interior Plateau of British Columbia. The topography indicates a stage of mature erosion, modified by later glacial action. To the north, wide valleys, with gently sloping sides, and broad, low divides, are the rule; while farther south the main streams occupy typical U-shaped, glacial valleys. The hilltops, everywhere, show evidence of glacial erosion. From the valley of the West Fork the country rises gradually westward to the watershed between the Okanagan and Kettle rivers; while to the northwest it is broken by buttes and mesas, which appear to be remnants of a volcanic plateau. The Sawtooth mountains—running north and south—rise abruptly from the valley of Kettle river to the east, and serve to define the boundary of the Interior Plateau in that direction.

The area covered by the map is drained principally by the West Fork of the Kettle and its tributary, Beaver creek; while a strip about 3 miles wide on the eastern edge drains into the main Kettle river. The West Fork and the main Kettle cross the area in slightly converging valleys in a north and south direction. About 6 miles due north of Beaverdell, the West Fork takes a wide sweep to the west and comes back to its original course at that place. Beaver creek, rising near the Kettle river, flows to the south and west and enters a broad north and south valley about 4 miles above its junction with the West Fork at Beaverdell.

Within the area covered by the map sheet, the gradient of the main valley bottoms is fairly uniform, perhaps 25 to 40 feet to the mile. Within this area the Kettle river has the steep sides and flat bottom of a glacial valley. This is also true of the West Fork as far as Beaverdell, and for 4 miles up Beaver creek. East of Beaverdell, Wallace mountain rises abruptly to a height of about 2,000 feet above the valley bottom. Between the mountain and the valley of the main river, the country is rolling, with but few prominent points. Goat mountain—which is the highest point between the West Fork and Kettle rivers—though showing up in bold relief from the east, is not very much higher than the flat-topped hills to the west and northwest.

North of the transverse valley of Beaver creek the topography is flatter, and the elevation gradually decreases toward the north and east. An area of marked relief occurs in the northwest corner of the region, where Red mountain and The Nipple form two prominent points overlooking the country to the south and east. Goat mountain, Red mountain, and The Nipple, are nearly of the same elevation, perhaps 6,000 feet above sea-level; or about 3,500 feet above the lowest point in this part of the valley of Kettle river.

Climate and Agriculture.

The climate resembles that of other upland portions of the Interior Plateau, though it is perhaps drier than the western edge of that region. The summers are cooler than in the lower lying valleys to the south, and the winters are not so cold.

Little land has been cultivated, hay, and vegetables being the only agricultural produce. Fruit growing is still in the experimental stage, though it is understood that it has been successfully begun at Rock Creek, 35 miles down the valley.

Timber.

The country is well timbered; bull or yellow pine (*Pinus ponderosa*) grows in the lower valleys and on the more open hillsides, while tamarack (*Larix occidentalis*), and fir (*Pseudotsuga mucronata*) are more often found on the hills. There is enough large pine, tamarack, and fir left for extensive lumbering operations.

Transportation.

The district is connected by a good wagon road, which follows Kettle river and West Fork through Beaverdell to Carmi, with the Canadian Pacific and Great Northern railways at Midway. One branch of the road runs up the main Kettle to a point almost directly east of Beaverdell. A switchback road, with a remarkably low gradient, connects Beaverdell with the Sally and Bounty Fraction mining properties on Wallace mountain. There are a number of good trails on the mountain and up the main valleys, but pack trails over the remainder of the area are few and poor.

GENERAL GEOLOGY.

A large part of the area was not visited, and the following geological notes are based upon the examination of specimens collected and exposures seen in the course of preliminary topographical work. No attempt, will, therefore, be made to distinguish formations, to correlate them, or to define their areal boundaries.

Fine-grained aplites, in places cut by andesite and quartz porphyry dikes, occur east and south of Triple Lake valley. Andesite outcrops extensively along the Kettle river south of Canyon City; while older volcanics are found in the river bed north of that place.

Various plutonic types, such as granite, granodiorite, diorite, and monzonite, outcrop on the hills on both sides of the West Fork, also extensively along the east side of Kettle river. A large body of andesite occurs along the eastern side of the West Fork near the mouth of China creek. Basalts, andesites, breccias, and tuffs occur on the higher points near Goat mountain, and in the northwestern corner of the area.

ECONOMIC GEOLOGY.

The more important mineral deposits of the district are the silver-lead ores of Wallace mountain and the gold-silver occurrence at Carmi. Good values in silver have been found at many places along the West Fork valley. A good deal of prospecting has been done near the Triple lakes, on Arlington hill, and in the country between the West Fork and Beaver creek; and ores carrying fair values in copper, silver, and gold have been opened up in several places.

Wallace Mountain.

The silver ores of Wallace mountain occur in a series of fissure veins in granite. The ores consist of galena, with argentite, sphalerite, ruby silver, and tetrahedrite. These are associated with quartz, pyrite, and in rare cases arsenopyrite. Native silver occurs near or in certain fault planes, and silver chlorides are sometimes encountered near the surface.

OCCURRENCE AND STRUCTURE OF VEINS.

The veins vary in width from a thin stringer to perhaps 10 feet. They strike east and west, and dip south, at angles varying from 45° to almost 90°. A dip to the north has been noted, but may in this case be due to local displacement.

The vein matter consists of silicified and altered granite, accompanied by one or more bands of quartz. There is, generally, a sharp break between the composite vein material and the fresh granite, forming a well-defined foot and hanging-wall. The relative proportion of quartz and altered granite varies greatly; the stringers of quartz are generally found near the hanging and foot-wall.

The heavy stringers of quartz, and occasional regular banding of the sulphides, suggest that part of the vein was formed by fissure filling. The granite within the veins shows evidence of crushing. Quartz fills the spaces between the fragments, and

quartz and sulphides can be seen replacing the original minerals of the granite. Replacement of the country rock in the walls is not very evident in the hand specimens, and the sulphides appear to be absent; it seems probable, however, that microscopic study will show some replacement of the country rock to have taken place at least close to the vein.

In some instances the ore occurs in or near dikes of dense, fine-grained aplite. These are from 3 to 8 feet wide, and strike east and west.

POST-MINERAL FAULTING.

The veins are cut by a series of fault planes with a north and south strike, and a dip to the west of from 35° to nearly 90°. Instances of a northeast-southwest strike are said to occur. The displacement, which varies from 1 foot to over 300 feet, is toward the south, when following the lead from west to east. There are one or two exceptions to this rule, but the displacement in such cases is not very great. There appear to be two series of north and south faults. In the Rob Roy No. 7 tunnel of the Sally group a fault plane with a dip of 80° cuts one dipping 35°. There appears to have been an upward movement on the western side of the steeper fault, with a displacement of over 300 feet.

Along the fault planes between the broken ends of the veins there is usually a thin band of gouge—kaolinized vein material, and partly decomposed ore. Thin plates of native silver and calcite are usually found in or near these fault planes.

OXIDATION.

There is little evidence of the oxidation of the vein material by surface waters. In some of the mines of the Sally group, oxidized ore has been found to a depth of 75 feet, but in general the fresh sulphides are encountered quite close to the surface. The leached vein matter or gossan has doubtlessly been removed by glacial scouring.

ORE VALUES.

On account of the small amount of underground development, it is not possible to determine variations in the character or values of the ore relative to depth from the surface. Values vary greatly in a lateral direction: bunches of ore which after sorting by hand averaged $200 to the ton, have been taken from leads which in other places proved almost barren. The occurrence of pay ore along a lead is, however, fairly constant. As an instance, the Sally mines—with 2,000 feet of tunnelling—have shipped nearly 700 tons of ore averaging over $100 to the ton, and have about 4,000 tons on the dump averaging perhaps $25 per ton. This was done with very little auxiliary stoping.

DISTRIBUTION.

The boundaries of the area containing the silver-bearing deposits have not been definitely determined. Properties of the shipping class lie within an area of about 3 square miles on the western and southern slopes of Wallace mountain. The Sally mines are 3 miles by wagon road from Beaverdell, and 1,500 feet above the town; while the properties on the far side of Dry creek are about 2½ miles farther east.

MINING DEVELOPMENT AND PRODUCTION.

On the western slope of the mountain the ore has been worked by tunnels driven along the veins; while in other parts of the area shafts have been sunk from 40 to 100 feet deep, and the ore taken out by drifting and stoping.

The ore shipped from three of the properties totals 925 tons, valued at about $98,500. Of this, the Sally group produced $73,000; the Bounty Fraction and

Duncan, close to $16,000; and the Rambler, a little over $9,500. These returns were furnished by the managers or owners of the mines. Ore has also been shipped from the Bell claim.

A serious hindrance to the development of the camp is the excessive cost of transportation. The cost of freighting from the mines to Trail, with smelter charges, amounts to from $30 to $35 per ton; the freight charges to Midway alone are $16 per ton. On this account, ore averaging less than $100 per ton cannot be handled with any great profit. Railway connexions to Beaverdell, and a concentrator to eliminate the slow and expensive hand-sorting of the ore, would greatly facilitate the opening up of the silver deposits.

The Carmi Mine.

This gold and silver bearing deposit is situated southwest of the now abandoned town of Carmi, 5 miles above Beaverdell. The mine has been abandoned for some time, and the shaft is filled with water. The following notes were made from what could be seen on the ore dump and surface outcrops.

ORES AND THEIR OCCURRENCE.

The ores consist of zinc blende, chalcopyrite, pyrite (probably gold-bearing), and galena in a gangue of quartz, and ferruginous dolomite. A small amount of molybdenite is also present.

The ore occurs in a vein from 2 to 4 feet wide, with an east and west strike, and a dip to the south of about 45°. The country rock is a gneissic granite of the same character as that on Wallace mountain. The vein filling consists partly of quartz and partly of a dense, compact rock of the same appearance and texture as the dikes on Wallace mountain. The proportion of quartz varies along the vein. Ore is found in both quartz and the compact vein filling mentioned above.

MINING DEVELOPMENT AND PRODUCTION.

A shaft 183 feet deep has been sunk on the western end of the property, and 200 feet of drifting done from it. There is also a tunnel 86 feet long, and another shaft 40 feet deep. A mill with a ten stamp battery was erected in 1904, and 400 tons of waste treated with amalgam plates and by the cyanide process.

Between 1899 and 1900, nearly 900 tons—averaging $26 per ton in gold and silver—were shipped to the smelter at Greenwood.

A RECONNAISSANCE ON THE UPPER FRASER RIVER BETWEEN FORT GEORGE AND TÊTE JAUNE CACHE.

(G. S. Malloch.)

INTRODUCTION.

The main line of the Grand Trunk Pacific railway, now under construction, crosses the Rocky mountains by the Yellowhead pass, and descends to the Fraser river, which it follows for 300 miles to Fort George, at the mouth of the Nechako. This part of the route follows the line surveyed in 1876 by the Canadian Pacific Company for their main line, but abandoned in favour of that by the Kicking Horse pass. Their survey of the Yellowhead route was begun in 1871, and in that year, also, Dr. A. R. C. Selwyn began the work of the Geological Survey in British Columbia. He received instructions to extend his explorations to the Yellowhead pass if time should permit. Owing to the lateness of the season, he did not reach the pass; but, after ascending the North Thompson and crossing to the Fraser, at Tête Jaune Cache, he followed the river up to within 20 miles of his objective point.[1] In 1893, Mr. James McEvoy made an exploratory survey of the old Canadian Pacific Railway route between Edmonton and Tête Jaune Cache, an account of which is published in the Annual Report for that year.[2] From Tête Jaune Cache, however, to the vicinity of Fort George—which was visited by Dr. Selwyn and Dr. G. M. Dawson in 1875, and by the latter again in 1876[3]—no geological examination had been made of the Fraser by members of the Geological Survey until the summer of 1909, when the writer was instructed to undertake the work. He was assisted by A. C. T. Sheppard, and P. A. Fetterly. The Fraser river was ascended from Fort George in canoes, and, on the return journey from Tête Jaune Cache, a traverse of it was made with micrometer and plane-table. The distance between these points is nearly 315 miles. The journey up river occupied twenty-one days, while twenty-six days were spent in traversing.

The geological examination was necessarily a hurried one, and the scarcity of exposures on the river banks added to the difficulty of studying the different formations. Twelve days were spent in climbing and exploring the mountains flanking the valley, but although almost continuous exposures were seen on them, especially in the gullies of streams descending their slopes, the strata were invariably so crumpled and faulted that nowhere was an opportunity afforded for measuring a satisfactory section. It is believed, however, that had time permitted, much more detailed information could have been gathered by camping near timber line on the different mountain ridges and traversing their crests.

GENERAL CHARACTER OF DISTRICT.

Topography.

Topographically, the portion of the Fraser valley examined falls into two main divisions. From Tête Jaune Cache down to the Grand cañon—100 miles above Fort George—it runs between two parallel ranges of mountains, while for the remainder

1 G.S.C. Report of Progress for 1871-2, pp. 16-72.

2 G.S.C. Annual Report, New Series, Vol. XI, 1898, Part D.

3 G.S.C. Report of Progress, 1875-6, pp. 28-83, and pp. 233-265; and Report of Progress for 1876-7, pp. 17-94.

of the distance it traverses the Interior Plateau, where the hills are irregularly distributed, and usually cannot be seen from the river. The trough which the Fraser occupies in the first of these topographic divisions is one of the striking features of the mountainous region of eastern British Columbia. It extends from the International Boundary northwest for 800 miles, and in origin is evidently quite independent of the present drainage system; for in it the Kootenay, Canoe, and Findlay rivers flow southeast, and the Columbia, Fraser, and Parsnip, northwest. Moreover, the trough, at the divides between the different drainage systems, is as wide and has as gentle a slope as where it is occupied by any of the large rivers mentioned. This is well exemplified at Tête Jaune Cache, where the Fraser enters the trough from the east and where, although the part below the elbow is drained by a small tributary only, carrying about one-tenth of the amount of water in the main river, the trough is not contracted nor the gradient changed.

On the other hand, the lateral tributaries of the Fraser break through narrow gaps in the side walls of the trough and have steep gradients until they reach the strip of flat land which lies along the river. This strip is from 3 to 5 miles wide, while the distance across the trough from peak to peak averages about 10. The ranges flanking the trough are lower than the succeeding ones, and decrease in height from Tête Jaune Cache to their northern ends near the Grand cañon. At the former place they rise 7,000 feet above the valley, while near the latter they are not much more than 4,000 feet above it. There is, however, a break in this general decrease in height. The range on the northeast side at a point opposite the mouth of Goat river, and the range on the southwest side at a point below the gap of Dome creek, suddenly increase in elevation. From these points the ranges become lower, but the rate of decrease is much more rapid on the southwest side, so that the range there ends above the Grand cañon; whereas the range on the other side extends to Toneyquah creek. From the river a few glimpses were caught of a long range extending northwest from near the mouth of Big Salmon river; this is, doubtless, the continuation of one of the walls of the trough beyond the wide break through which the Fraser escapes from it. The continuation of the trough in that direction is described by Mr. R. G. McConnell.[1]

The Fraser pursues a most tortuous course in the strip of flat land in the centre of the trough, swinging from side to side in broad, sweeping curves, and sometimes approaching within short distances of the enclosing ranges. In many cases very narrow necks are all that remain to separate a higher from a lower bend, and numerous 'oxbow' lakes along the course of the river bear witness to the frequency with which similar necks have been cut through in the past. The tortuous course of the river is due to the excessive load of sediment which it carries, and not to a low gradient. The sediment consists largely of flakes of mica and rock flour produced by the grinding of large glaciers on the micaceous schists and gneisses, of which the mountains are chiefly composed. Glaciers are comparatively rare on the side walls of the trough, but are common in the higher ranges on either side of them. The Fraser is not particularly turbid at Tête Jaune Cache, but several of its tributaries, especially Sand creek and Rau Shuswap river, are heavily loaded with silts. The latter is the largest tributary the Fraser receives in this part of its course, and drains a high, mountainous country, in which many large glaciers were seen. On the other hand, many of the smaller tributaries are clear, except after heavy rains. Many of them do not head in glaciers, or else have lakes on their courses which act as catchment basins for sediment derived from glaciers.

As has been stated, the country through which the Fraser flows from the Grand cañon to Fort George, belongs to a second topographic type known as the Interior Plateau, and differs from the first in the absence of regular mountain ranges. It is

[1] G.S.C., Annual Report, Vol. VII, 1894, pp. 18-19 C.

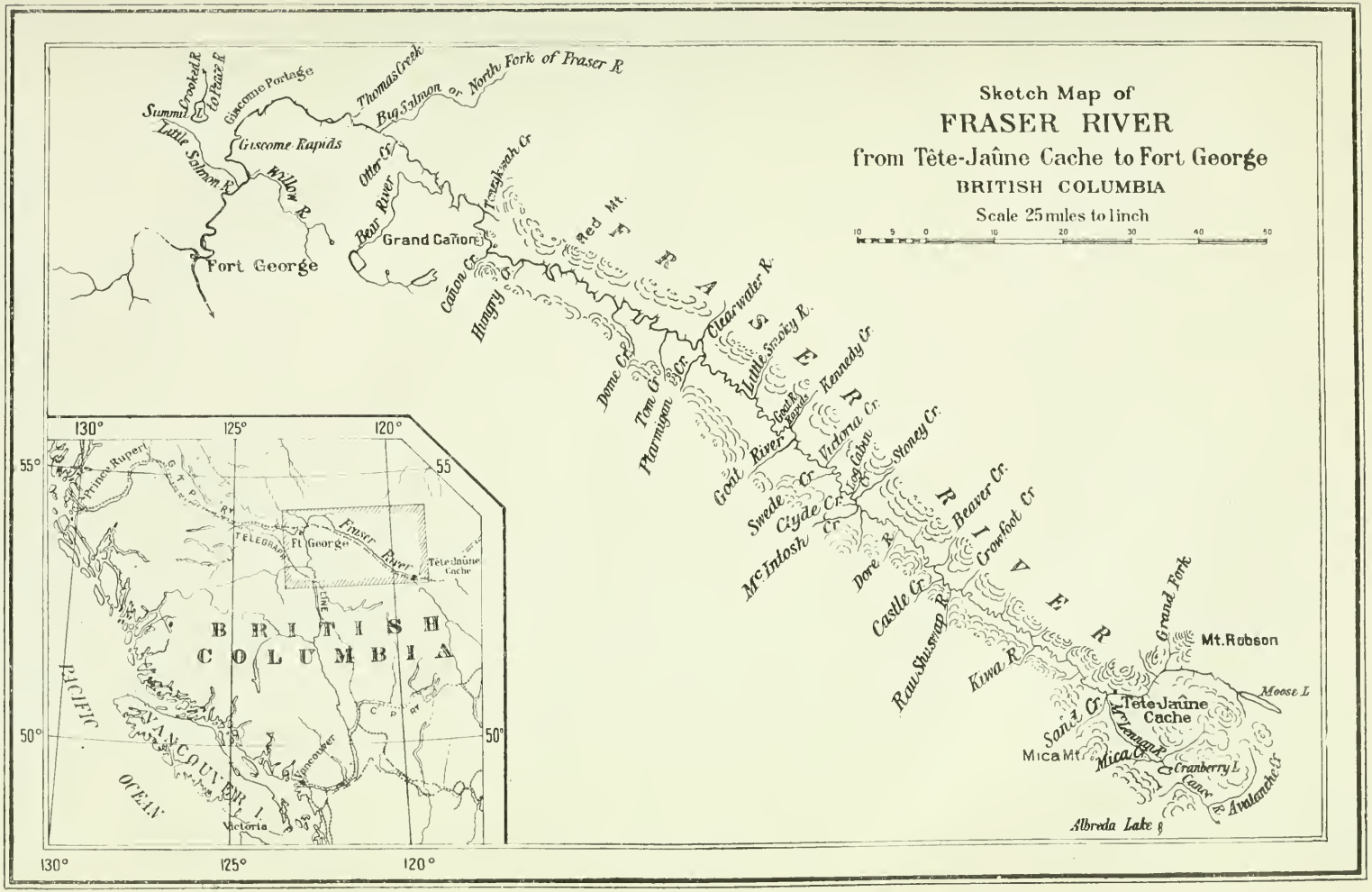
Sketch Map of
FRASER RIVER
from Tête-Jaune Cache to Fort George
BRITISH COLUMBIA
Scale 25 miles to 1 inch
10 5 0 10 20 30 40 50
Fort George
Grand Canon
Red Mt.
Canoe Cr.
Hungry Cr.
Dome Cr.
Tom Cr.
Clearwater R.
Little Smoky R.
Kennedy Cr.
Goat River
Goat Rapids
Victoria Cr.
Stoney Cr.
Swede Cr.
Clyde Cr.
McIntosh Cr.
Dore R.
Beaver Cr.
Crowfoot Cr.
Castle Cr.
Raushuswap R.
Kiwa R.
Grand Fork
Mt. Robson
Moose L.
Tête Jaune Cache
Sand Cr.
Mica Mt.
Mica Cr.
Cranberry L.
Albreda Lake
Bear River
Otter Cr.
Willow R.
Little Salmon R.
Giscome Rapids
Giscome Portage
Thomas Creek
Big Salmon or North Fork of Fraser R.
Summit Lake
Crooked R.
to Peace R.
Prince Rupert
G. T. P.
Fraser River
Tête Jaune Cache
BRITISH COLUMBIA
PACIFIC OCEAN
VANCOUVER I.
Victoria
Vancouver
130°
125°
120°
55°
50°

Fig. 1.

characterized by extensive upland areas intersected by an irregular system of comparatively broad valleys. Numerous lakes occur both in the uplands and in the upper reaches of the valleys, and the streams are clear and become quite warm in summer.

Climate and Agriculture.

The rainfall is heavy throughout the district, particularly in the country in the vicinity of the Grand cañon, where the prevailing westerly winds, deflected by the ends of the ranges bordering the river, are forced to ascend. Here, the rainfall is excessive, and it is doubtful whether grain crops could be successfully ripened. The temperature in summer is very equable, and in the valley white frosts are rare before October. The area of farming land about Fort George is very large, and the soil excellent. Westward along the Fraser, it is rather light, owing to the large quantity of mica in the river silts.

Fauna and Flora.

The region abounds in wild game of various kinds, especially between Little Smoky and Rau Shuswap rivers. Near Fort George and Tête Jaune Cache, the quantity of game is kept down by the Indians, who have their headquarters there. Black bear and moose are particularly numerous, and it is almost impossible to land on any of the bars along the river without seeing tracks of both. Beaver are numerous, and may often be seen swimming in the river in broad daylight; while nearly every aspen near the water has been cut by them and many of their dams obstruct the smaller tributary streams. One herd of wapiti was seen, near the timber line. Numerous trails, beaten deep into the higher slopes, bear witness to the large number of goats which winter there but doubtless summer on the higher ranges on either side. Grizzly and cinnamon bears are reported to be common, but none were seen. The smaller fur-bearing animals are numerous. Rainbow and silver trout, and whitefish are plentiful in the Fraser and many of its tributaries. Salmon ascend the river to Tête Jaune Cache, where they are speared in large numbers while crossing shallow bars; the run was at its height there about August 25.

The timber of the district is large, and grows thickly; the heavy rainfall in the central portion of the district traversed has protected it from fire, though large areas near Fort George and Tête Jaune Cache have been destroyed. Spruce, both black and white, is the principal tree, ranging from the timber line to the river bottoms. Along the latter, balsam, white birch, and, in the more sandy parts, cottonwood, are nearly as common. Cedar, in most cases, is confined to the lower slopes of the mountains, but also occurs near the river wherever the banks are rocky and the drainage good. Some of them reach a large size; specimens 12 feet in diameter being seen. Above the belt of cedar there is usually one of hemlock, and above that, spruce and balsam to the timber line. No larch was seen nor pine, except Banksian pine, which, with the aspen poplar, is common in the drier parts about Fort George and Tête Jaune Cache. Douglas fir also occurs along the river terraces at the latter point, and some fine tracts of it were seen in the vicinity of Fort George. All kinds of wild berries abound, and are picked by the Indians and dried on leaves for use during the winter. Underbrush is very thick, except in the regions recently burnt over, and the alders along the river and the stream often attain diameters of 8 inches, and grow so thickly in places that it is almost impossible to force one's way through them. They also extend for a considerable distance up the slopes of the mountains. The 'devil's club' is also present in unwelcome abundance wherever the ground is damp and sufficiently shaded to protect it from the sunlight.

Transportation and Communication.

Fort George is reached from Ashcroft by a stage line to Soda creek, and from there by steamer. In seasons of high water a transfer is usually made from one

steamer to another at Fort George cañon, 15 miles below the Fort. The steamers being of light draught, and having powerful engines, might be able to ascend the river to Tête Jaune Cache, though the Grand cañon would be difficult to pass and might prove to be altogether impassable, at high water. Tête Jaune Cache can be reached by pack train from Edmonton across the Yellowhead pass, or from Kamloops, by ascending the North Thompson. There is a waterway, also, up the Columbia from Revelstoke, or down from Golden to the mouth of Canoe river, then up the latter almost to its head, where a short portage leads to Cranberry lake, which drains to the Fraser by McLennan river. This route should only be attempted by expert canoemen.

Commercial Possibilities.

The building of the Grand Trunk Pacific will make the timber in the Fraser valley valuable; for the low cost of hauling it over the easy grades of the Yellowhead pass will, doubtless, enable it to compete successfully with the inferior timber growing on the eastern slopes of the Rockies.

GENERAL GEOLOGY.

As already stated, the geological examination was much too hurried to permit more than an examination of the outcrops on the river banks, and, in a few places, on the bordering hills and mountains. These data are insufficient to afford a complete geological section in a region where the rocks have been folded, faulted, crumpled, and greatly metamorphosed; and where there is a marked scarcity of fossil evidence. The district lies between two areas in which the geology has already been worked out in some detail, but except in a very general way the formations of the two districts have never been correlated. The first of these areas is the Rocky Mountain region, in which a section was measured by Mr. R. G. McConnell[1] along the main line of the Canadian Pacific railway. This section was found by Mr. J. C. McEvoy[2] to correspond closely to that exposed in the country immediately east of the district examined during 1909, and in which, on the whole, the same parallelism holds true. The second area is the Interior Plateau of British Columbia, which has been described in numerous reports by Dr. G. M. Dawson[3]; while the Cariboo Mining district, lying a comparatively short distance southeast of Fort George, was examined by Amos Bowman.[4]

TABLE OF FORMATIONS.

River drift	Recent.
Glacial drift	Quaternary.
('a' from west; 'b' from east.)	
Lignite Tertiary?	Miocene.
Quesnel River series?	Cretaceous?
Banff series	Carboniferous and Devonian.
Castle Mountain series	Upper Cambrian.
Bow River series	Lower Cambrian.
Shuswap group?	Pre-Cambrian?

Shuswap Group.—A series of mica schists, garnetiferous schists, and gneisses, occurring in the mountain range bordering the trough on the southwest. has been referred to the Shuswap group by Mr. McEvoy. These rocks form the upper part of the range from opposite Tête Jaune Cache to the gap of the Rau Shuswap river. Mr.

1 G.S.C., Annual Report, 1886, Part D.

2 G.S.C., Annual Report, Vol XI, Part D.

3 See especially G.S.C. Annual Report, Vol. VII, Part B.

4 G.S.C., Annual Report, 1887, Part C.

McEvoy[1] states that some of the finer grained gneisses are certainly intrusive. Mica mountain, where Mr. McEvoy got his specimens, was not visited; and elsewhere no rocks were seen by the writer from which this conclusion could be verified either from a study of hand specimens or from the field relations, and the author is disposed to regard the schists and gneisses as metamorphosed sediments. They dip to the southwest at comparatively high angles, and overlie beds of garnetiferous schists, some of which contain large crystals of staurolite. These in turn overlie beds of impure crystalline limestone, resting on mica schists, the sedimentary origin of which is revealed by weathered surfaces where rounded grains of quartz can be detected. A similar section was seen at other points on the same side of the trough, and the author suggests as an alternative hypothesis that, the schists and gneisses are the metamorphosed equivalents of the grey quartzites which occur in the Castle Mountain series; while the trough may have been eroded along the outcrop of the soft calc schists at the base of the formation. In a region where faults are numerous the evidence to support this hypothesis is far from being conclusive. The gneisses are cut by large dikes of pegmatite holding crystals of muscovite, some of which measure over 20 inches across.

Bow River Series.—The Bow River series consists of a succession of fissile micaceous and graphitic schists, dark coloured limestones, and a peculiar conglomerate containing rounded pebbles of quartz and comparatively fresh feldspar, with numerous flakes of sericite, which, in some cases, give the rock a certain amount of schistosity. One of the quartz pebbles measured 6 inches in diameter. In some places the conglomerate contains fragments of the dark coloured limestone with which it is interbedded. Many quartz veins, holding flakes of sericite and crystals of siderite, have been developed in this formation.

This series forms the range bordering the trough on the northeast from Tête Jaune Cache to the high mountain opposite the mouth of Goat river. The general dip is southwest, as is the case in the range opposite, but the beds have been thrown into a number of crumples. To the east, however, an anticline occurs, and the beds of this formation were seen to dip under the limestones, dolomites, and quartzites of the Castle Mountain series, which form the mass of Mount Robson and other high mountains in that direction.

Castle Mountain Series.—The beds belonging to the Castle Mountain series were not examined closely, and the line between them and the succeeding Banff series was not made out. In McConnell's section[2] they are described as being composed of a succession of massive dolomites and limestones, with calc schists and argillites; but McEvoy mentions[3] the occurrence, also, of thick beds of grey quartzite. Beginning on the mountain opposite Goat river, this formation crosses the river at the foot of Goat River rapids, where talcose and chloritic schists and quartzites were seen. Similar rocks were found on the hills above the gap of Tom creek on the opposite side of the trough, and if the suggestion as to the age of the Shuswap gneisses is correct, it might be possible to trace the progress of the metamorphic action, by which it is supposed they were produced from the grey quartzites. The gneisses were last seen a little above the gap of Rau Shuswap river.

Banff Series.—As stated above, the Banff series could not be definitely separated from the preceding series, nor could the position of the different beds relative to one another be made out. This was due to the want of continuous exposures and to the amount of crumpling and faulting which the beds have suffered. The predominating beds are massive limestone, and are usually coarsely crystalline and fairly pure.

1 G.S.C., Annual Report, Vol. XI, Part D, p. 38.
2 G.S.C., Annual Report, 1886, Part D, pp. 24-29.
3 G.S.C., Annual Report, Vol. XI, Part D, p. 32.

Beds of brownish-yellow shale overlie large thicknesses of limestone on both sides of the trough, and may be the highest beds represented. At the Grand cañon a section was measured which showed thick limestone beds overlying dolomites, micaceous shales, and quartzites. Some of the latter are banded in red and greenish layers, the colours being imparted by quartz pebbles, some of which are as large as peas. Some pebbles of black chert also occur in them. Above the limestone were seen talcose schists and black carbonaceous shales, and above these, more limestone. Two varieties of corals were found on the slope of Red mountain, which Mr. L. M. Lambe believes to be of upper Devonian age; but, unfortunately, they came from beds separated by a crumple, and the sequence of beds observed here was not duplicated at any other point examined. It is evident, however, that they do not represent the top of the series.

Besides forming the ends of the ranges bordering the trough, this formation forms an irregular line of hills across the valley through which the river has cut the Grand cañon. The last exposures of the limestone occur in the river a little below Thomas creek, where they dip to the west and evidently pass below younger strata.

Quesnel River Series.—Greenish schists, grey sandstones, and a heavy bed of conglomerate containing pebbles of quartzite and of badly decomposed volcanic rocks, are referred to the Quesnel River series,[1] doubtfully, for it is possible that they represent the base of the Tertiary. However, the degree of metamorphism the schists have undergone, and the comparatively high angles at which some of the beds dip, favour the view that they belong to the Cretaceous. They outcrop on both sides of Giscome rapids; the conglomerate, the last seen, disappearing a little below the mouth of Little Salmon river.

Lignite Tertiary.—No exposures of rock were seen for 25 miles above Fort George, but there is an exposure of the Lignite Tertiary a short distance below the Fort; and Dr. Dawson supposed[2] that the measures underlie much of the country. A small, isolated exposure of these beds was seen on the east bank near the head of the Giscome rapids.

Glacial Drift.—The whole region has been glaciated, and boulder clay occurs at different points along the river. These deposits were formed by two sets of glaciers; the first of which descended into the Interior Plateau from the mountains to the east, and the second from those to the west. The drift of the latter is characterized by the presence of granite fragments from the Coast range, and volcanic rocks from the western part of the plateau. On the other hand, that from the east contains fragments of older rocks, and it alone is seen on the river from Tête Jaune Cache to Giscome rapids, where it is overcapped by the drift from the west. A band of gravel separates the two boulder clays, and doubtless represents an outwash formed when the second glacier was advancing. The rapids seem to be due to accumulations of boulders washed from the boulder clay through which the river has cut its channel. The Goat River rapids, higher up, are also due to thick accumulations of boulder clay, probably deposited during a temporary halt in the retreat of the glacier from the east. An esker, composed of sand and gravel, and about 300 feet high, occurs at the foot of the rapids.

River Drift.—Great thicknesses of river drift are exposed at different points along the Fraser. Where it is exposed to the bottom, the river drift is usually found to rest on boulder clay, but sometimes on bed-rock. The drift consists of clays, sand, gravel, and beds of peat. As one would expect, the clays are found generally on the banks along parts of the river where the current is comparatively slow; while the

[1] G.S.C., Annual Report, 1887, Part C, pp. 17-19.

[2] G.S.C., Report of Progress for 1875-6, pp. 256-257.

thickest deposits of sand occur below the different rapids. In many cases, however, layers of sand and clay alternate, and when this is so, many landslips have taken place from the cut banks. These are easily recognized by the discordance in dip of the different layers and by the overturning of trees. Some of the slips extend back for some distance from the river; in one case an angle of only 18° was measured from the foot of one of these slides to the top of the bank from which it had come. Many of the clays have been hardened to some extent by calcareous cements.

The beds of peat seem to have been formed in two ways: many of the smaller and more irregular beds have been formed by accumulations of water-logged drift wood in the shallow water at the edges of the river, which were afterwards covered by deposits of silt; while others are too pure to have had such an origin, and probably represent vegetable matter which decayed where it grew, and was afterwards buried by river deposits. In many cases the river would be forced to build up a portion of its bed when its course was checked lower down by the growth of fans of tributary streams, and this may have occurred several times, so that more than one deposit of peat might be buried. In one cut bank two regular seams of peat, each over 12 inches thick, were seen.

The fans of the tributary streams consist largely of gravel, and their occurrence at all the stream mouths emphasizes the difference between the gradients of their valleys and that of the bottom of the trough. At the bottom of the river drift there is usually a bed of gravel, which is stained to different shades of red and yellow, and often cemented to a conglomerate by iron rust.

ECONOMIC GEOLOGY.

With the exception of a mica-bearing pegmatite dike southwest of Tête Jaune Cache, and some small crystals of zinc blende picked up on the mountain north of Tête Jaune Cache, and a piece of float in Tom creek which contained a small quantity of chalcopyrite, no evidence of mineralization in the district was seen except in the sericite- and siderite-bearing quartz veins in the Bow River series. These are very common, and evidently carry some gold, but it does not seem to be present in paying quantities.

Beaver River Gold Claims.

The district has been very thoroughly prospected, but so far as the writer's knowledge goes, mineral claims have been staked in only two localities. The first of these is where the Beaver River Gold claims are located, about 30 miles below Tête Jaune Cache. Here, two quartz veins traverse the schists and conglomerates of the Castle Mountain series. The schists are very much contorted, and the veins expand into broad pockets where they cross them, but are much narrower in the conglomerates. The westerly vein is the larger, and can be traced from the north side of Beaver river to near the summit of the mountain south of it. It strikes N 41° W, and dips at about 40° to the southwest. At the largest showing it is 150 feet wide. Here, the quartz is traversed by veinlets of sericite, and at certain points crystals of siderite occur which weather to iron rust on the surface. Near the borders some graphitic and chloritic material occurs, which has doubtless been derived from the dark micaceous schists which form the side walls. It was reported that samples had been assayed and yielded as high as $60 per ton. Chippings taken at intervals across the vein show only traces of gold, and similar chippings taken from a second point higher up where the vein cuts the conglomerate, were no richer. The second vein was examined at a point about a quarter of a mile north of the big showing. It is about 30 feet wide, and contains rather more sericite and siderite, but a sample yielded only a trace of gold. A trail has been cut from the Fraser to within a short distance of the claims.

Mica Claims South of Tête Jaune Cache.

The second group of claims is situated on the range southwest of Tête Jaune Cache, and on either side of Sand creek. They are located on a pegmatite dike traversing the Shuswap group, and containing large crystals of muscovite of excellent quality. The deposits on Mica mountain were visited by Mr. McEvoy in 1898,[1] and are described in the Annual Report for that year. The deposit examined in 1909 was staked recently by Teare brothers, of Lacombe. Their claims extend from the foot of Mica mountain across Sand creek and to the top of the mountain north of it. The pegmatite dike, where the best showings occur, is over 50 feet wide, and sends stringers into, and includes pieces of, the surrounding schists. The large crystals occur on either side of a central filling of quartz about 5 feet wide. Here, a crystal 14 by 22 inches was found, and many as large as 8 by 10 inches were seen. The quartz of the central vein is massive, white in colour, and more opaque than that in the rest of the pegmatite. The main mass of the latter also contains many crystals of muscovite, but these are smaller, the largest seen measuring about 6 by 8 inches. It is estimated that about 5 per cent of the entire dike was muscovite. Another dike of pegmatite, also about 50 feet wide, occurs about 400 yards east of the first, but the quantity of muscovite in it is much less and the crystals very small. It has no central filling of quartz. The dip of the dikes is nearly vertical, and the first strikes S 21° E. The muscovite is of a slightly greenish cast, but thin lamellæ appear perfectly transparent. Inclusions of ferro-magnesian minerals occur in some crystals, but they are too minute to seriously affect their value.

Clays, Etc.

Some of the clays on the river bank would probably be found well adapted to the manufacture of brick. Some of the limestones of the Banff series are pure enough to make a good quality of lime. The deposits of peat mentioned are too small and too impure to be of value.

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[1] G.S.C., Annual Report, Vol. XI, Part D, p. 39.

SLOCAN DISTRICT, BRITISH COLUMBIA.

(O. E. LeRoy.)

INTRODUCTION.

The area covered by the Slocan geological map sheet will comprise about 260 square miles in the mining divisions of Ainsworth and Slocan. It will include all the principal centres in which the mining of silver-lead and zinc ores is being carried on between Kootenay and Slocan lakes, from Fourmile basin on the south, to Whitewater on the north. In this district transportation facilities are afforded by two railways, namely, the Canadian Pacific railway running from Roseberry to Sandon, and the Kaslo and Sandon railway connecting Kaslo with McGuigan. It is hoped that before long the latter road will resume its service into Sandon. Owing to the June freshet, the service was much disorganized this season, and Sandon was without railway communication from June until the latter part of October, thus preventing the shipping of ore during that period.

The greater portion of the area was geologically mapped this season, and a large number of claims and mines were examined. In the case of the latter, the hearty co-operation of the mine owners was of great assistance in facilitating the work. It is expected that about half of another season will be required to complete the sheet. During the season just past the writer was assisted in a most efficient manner by Mr. C. W. Drysdale.

At the present stage of the investigation only a very general statement can be made regarding the geology and the ore deposits, as it is felt that more data are required before making public any definite conclusions.

TOPOGRAPHY.

The area comprised in the Slocan map sheet lies wholly within the Selkirk range, which here is made up of a series of rugged ridges with no regular trend. The general altitude of the crests varies from 6,000 to nearly 8,000 feet, with an occasional higher peak. The upper portions of the ridges are usually steep and bare, while the lower portions are covered with a mantle of 'wash' or glacial drift of varying thickness.

The district is crossed by one of the main transverse valleys of West Kootenay, extending from Kaslo to New Denver. The valley is occupied by Seaton and Carpenter creeks flowing west, and Kaslo creek flowing east, the divide being at Bear and Fish lakes. The tributaries of these creeks flow with steep gradients in rather sharp V-shaped valleys. Kaslo creek flowing into Kootenay lake, and Wilson, Carpenter, and Fourmile creeks emptying into Slocan lake, have built up considerable deltas, on which are situated the towns of Kaslo, Roseberry, New Denver, and Silverton respectively.

GENERAL GEOLOGY.

The principal rock series in order of age are the Shuswap, Selkirk, and Slocan. The former is Pre-Cambrian; but at present no definite position as to age can be assigned to the two latter series, owing to the structural relations not having been fully worked out and to the apparent absence of fossils. Besides the above there are numerous intrusions of igneous rocks, ranging from quartz porphyries and granites to diorites and even more basic types. They occur chiefly in the area underlain by the Slocan series.

Shuswap Series.

The Shuswap series is developed as a comparatively narrow band along the west shore of Kootenay lake, and consists of interbedded quartzites, crystalline limestones, gneisses, and schists, with intercalated sills of granite, diorite, etc. The general strike makes a slight angle with the trend of the shore, and varies from N 15° W to N 25° W. with southwest dips from 45° to 85°. The series also occurs along the west shore of Slocan lake in small, isolated exposures.

Selkirk Series.

The Selkirk series occupies a roughly triangular area in the north and northeast part of the sheet, and is composed in the main of greenstone schists, with subordinate quartzites, silicified ash rocks, breccias, limestones, and phyllites. Masses of serpentine also occur, and represent completely altered basic intrusives. The trend of the series varies from N 15° W to east and west. No contact has yet been found with the underlying Shuswap, and the contact with the Slocan series, where noted, has the character of a thrust fault along the axis of a sharp fold.

Slocan Series.

The Slocan series occupies the main area of the sheet, and consists of interbedded dark grey quartzites, black carbonaceous slates and argillites, and grey and black limestones with all grades of transitional types. Adjacent to the granite intrusions the slates and limestones have been altered to andalusite and hornblende schists, and impure marbles respectively. With local exceptions, the general trend is from N 65° W to west, with high dips either to the south or north. Local crush zones accompanying faulting are common, but, so far as noted, the displacements are small.

Igneous Rocks.

The igneous rocks later than and associated mainly with the Slocan series, are of three ages at least. The oldest intrusives consist of a series of basic dikes and sills which are now almost completely altered to carbonates, mica, and quartz. In Jurassic or post-Jurassic time, quartz-porphyry, fine-grained granite, and quartz-diorite were intruded as dikes, sills, and stocks; they are genetically connected with the main granite batholith to the south, the northern portion of which enters the map area along Fourmile creek and the south fork of Kaslo creek. Cutting all the above rocks is a widespread series of basic mica and hornblende dikes and sills, which form the last evidences of igneous activity in the district.

ECONOMIC GEOLOGY.

The silver-lead and zinc ores occur in fissure veins in the rocks of the Slocan series, and occasionally in the quartz porphyry and granite. The dry or siliceous ores are found in the two latter rocks or adjacent to them in the quartzite and partly altered slate.

Of the deposits examined, the majority of the fissure veins follow the lines of master jointing in the stratified rocks, with a trend varying from N 25° E to N 80° E, with high dips either to the southeast or northwest. In the Whitewater basin, however, the trend of the veins is about due east with a dip to the south, and the fissures cut across the highly inclined beds of slate and quartzite. The fissures vary in length from a few hundred feet to 4,000 and 5,000 feet, and the width varies from a few inches to 40 or more feet. In the wider portions of the fissures the vein filling is largely crushed country rock.

The ore shoots are generally composite in character, and consist of a series of lenses of either clean or mixed ores of galena and zinc blende, the former in its purer state favouring the hanging-wall as a rule. In the granite the ore bodies are in the nature of stockworks, the ore following the main longitudinal and transverse lines of jointing.

The numerous small intrusions of porphyry have had a marked influence on the ore deposition by rendering the slates more resistant and permitting the existence of cavities.

Tetrahedrite (freibergite—'grey copper') is the most important silver-bearing mineral present with the galena, and occasionally with the blende. Native and ruby silver have but a limited distribution. Chalcopyrite in small quantities is usually present, and pyrite almost invariably, and in increasing quantity as the vein becomes poorer in lead and zinc. The lead-copper sulphate linarite was found in one locality only, occurring as crystals in a mixed ore of galena and chalcopyrite. The gangue mineral in most cases is siderite, with subordinate calcite and quartz. Occasionally the quartz predominates to the almost total exclusion of the siderite.

MINING.

During 1909, the shipping mines were the Whitewater, Whitewater Deep, Ruth (Hope claim), Richmond-Eureka, Rambler-Cariboo, Lucky Jim, Van-Roi, Cork, Reco, Slocan Star, Slocan Sovereign, Last Chance, Standard, Wellington, Bismark, Flint, Index, Utica, Alama, Gold Cure, Silver Glance, Fisher Maiden, Marion, Molly Hughes, McAllister, and Panama. The three last were producers of dry ore, and the Lucky Jim was the only property worked exclusively for zinc ore.

The Surprise, Washington, Noble Five, Hewitt, Payne, Bluebird, Rio, and Mountain Con are under development, and some of these will shortly become shippers.

Important development work has been carried on this season, which will have considerable influence on deep mining in the district; this includes the cross-cut tunnels on the Whitewater Deep and Sunset, the drift tunnels on the Surprise and Slocan King, and the extension of the lower levels of the Payne mine. If bodies of payable ore are found at these depths, it will stimulate more active prospecting and development on other properties now popularly believed to be worked out.

There are several properties now lying idle which should be producing; some of these afford opportunities for leasing by small companies or groups of individuals, and under a moderate royalty ought to yield satisfactory returns.

ADDITIONAL FIELD WORK.

The Cœur D'Alene District, Idaho.

In the early part of May a week was spent in the examination of the geological formations in the vicinity of Wardner and Kellog. Through the courtesy of Mr. Stanly Easton, the writer was given the opportunity to examine the more interesting sections of the Sullivan and Bunker Hill mine.

The Phœnix Camp.

The latter half of May, and two days in October, were spent at Phœnix in revising the work of the previous year, and in giving such assistance as was possible in prospecting other mineralized areas adjacent to the town.

The Sheep Creek Camp.

Two days in May, and the first half of July, were spent at Sheep Creek in extending northwards the geological boundaries previously laid down by Dr. R. A. Daly, in order to secure data for the completion of a sketch map of the whole camp.

TOPOGRAPHICAL WORK IN THE SLOCAN DISTRICT, B.C.

(W. H. Boyd.)

The past season—from June to nearly the end of September—was spent in making a topographical survey of the Slocan district for the publication of a map on a scale of 1/62500, or nearly one mile to the inch, with contours at intervals of 100 feet. Mr. H. Matheson, of the Geological Survey, was appointed to act as assistant.

The area of the district to be covered by the map sheet is about 276 square miles: 23 miles east and west, by 12 miles north and south. The sheet includes the towns of Kaslo, Three Forks, Sandon, New Denver, Silverton, and Roseberry, and all the principal mines of the Slocan.

Photo-topographical methods were employed, supplemented by plane-table and stadia traverses of the railways, main roads, and areas around the more important mines. Telemeter and aneroid traverses were also run of trails and some roads, and were found to give very good results for work on this scale.

Owing to the lateness of spring, the snow was very slow in disappearing from the summits and basins, so that during the month of June, and part of July, it was found impossible to carry on the triangulation control for the sheet, since it was very difficult, and in some places impossible, to erect signals or monuments. It was, therefore, found necessary to postpone the control work until later in the season. Work was carried on in the valleys until the snow melted sufficiently to render the summits accessible. Much valuable time, however, was lost from our inability to have the control work done at the beginning of the season. In the future, therefore, for the saving of both time and labour, as well as to secure better work, it would be advisable to endeavour, as far as possible, to have the control work of a district completed before the topographical work is commenced. In the Slocan much more work would have been accomplished, and more satisfactory results obtained, if this course had been followed; as it was, it was found impossible to complete the work this year; hence, about one-third of the area is still unmapped. Field work closed on September 23.

The following field assistants were attached to the party: Messrs. C. C. Galloway, M. S. Archibald, and E. Bartlett. Mr. E. E. Freeland was engaged in the field to complete the necessary staff of assistants. All did their work in a satisfactory manner.

After leaving the Slocan, I accompanied the Director on a visit to the Ainsworth cave, where we spent a day, and then made a trip from Argenta, on Kootenay lake, across the divide to Wilmer, in the Windermere district. On returning to Nelson, I went to Phœnix, where part of a day was occupied in work connected with the mapping of that area the previous summer; after which I left for Ottawa. On my way east, a day was spent with the Director examining Turtle mountain at Frank, Alberta.

RECONNAISSANCE IN EAST KOOTENAY, B.C.

(Stuart J. Schofield.)

INTRODUCTION.

My instructions for the field season of 1909 were, to study the geology of, and topographically survey an area in East Kootenay, B.C., enclosed by 115° 45′ and 116° 30′ west longitude, and 49° 15′ and 49° 45′ north latitude, the resulting map to be published on a scale of 4 miles to 1 inch. The area thus outlined contains 1,156 square miles, of which the northern half was covered during the season. It lies a short distance north of the International Boundary and east of Kootenay lake. The town of Cranbrook is situated a short distance within the eastern boundary of the sheet.

The photographic method was used in securing the necessary topographical details, and in connexion with this work and the study of geology, Mr. W. J. Galbraith proved a valuable assistant.

A topographical and geological map of the area made in 1899 by J. McEvoy has been published by the Geological Survey. The mining districts have been examined and reported on by W. F. Robertson, Provincial Mineralogist of British Columbia. Much valuable information concerning the economic geology of the district is contained in the Report of the Zinc Commission, published by the Department of the Interior. The geology of the districts immediately south of the present one, along the International Boundary, has been outlined by R. A. Daly in Summary Reports of the Geological Survey.

GENERAL CHARACTER OF DISTRICT.

The district lies within the Purcell range, which, on the south, is characterized by rather low, wooded hills; while north of Goat River summit the country becomes more rugged, the mountains usually having large glacial cirques sculptured in their precipitous walls. The vertical relief in the more mountainous region is from 4,000 feet to 6,000 feet. In marked contrast to this topography is that of the prairie region situated in Kootenay River valley along the eastern border of the sheet.

The drainage of the area is effected by St. Mary river, flowing easterly into Kootenay river at Fort Steele; Moyie river, emptying into Kootenay river in the State of Idaho; and Goat river, flowing south to Yahk on the Canadian Pacific railway, and thence west to join Kootenay river at its delta on Kootenay lake.

The climate is characterized by dry summers, rather long winters, and wet seasons in May and November. The snowfall in the prairie section is very light, but in the mountains 8 feet of snow is not unusual. For agricultural purposes, irrigation is necessary, and is practised in the prairie sections. Cattle and horses range all the year round in the lowlands if looked after in the months of February and March.

Many valuable timber limits have been located in the region. The trees are spruce, pine, hemlock, cedar, balsam, jackpine, tamarack, and poplar.

The larger animals of the region include the grizzly, cinnamon, and black bears; caribou, deer, goat, mountain lion, wolverine, and lynx. The martin, mink, skunk, weasel, and beaver are now becoming scarce. Marmots, gophers, and porcupines are rather plentiful.

Access to the region is furnished by the Crows Nest branch of the Canadian Pacific railway, and by a branch line from Cranbrook to Kimberly. Numerous good roads exist in the more thickly settled districts; while graded trails built by the provincial government penetrate the mountains.

The principal industries of the district are lumbering, mining, and agriculture.

GENERAL GEOLOGY.

Since the work of the past season was largely of a preliminary nature, much of the time having been devoted to topographical work, the geology and economic resources of the area are given but brief mention in this report.

The region is largely underlain by sediments, probably of Cambrian, though possibly of Pre-Cambrian age, into which numerous sills of diorite have been injected. A small stock of granite is the youngest rock in the district.

Mountain-building forces, acting probably at the close of the Laramie, have folded and faulted the formations, throwing them into great, open folds, but sometimes giving rise to overturned anticlines, overthrust faults, and mashing.

The chief ore deposits, those of lead-zinc ores, occur in the Kitchener formation, which contains the greater number of igneous intrusions. Copper-bearing deposits, gold-quartz veins and placers also occur within the region.

TABULAR DESCRIPTION OF FORMATIONS.

Pleistocene	Unconsolidated gravels and sands.
Jurassic?	Granite.
Cambrian?	Moyie formation.—Very thinly bedded, brown and grey weathering quartzites, metargillites and shales. Estimated thickness, 3,500 +.
	Gabbro and diorite sills.
	Kitchener formation.—Thin bedded, rusty-weathering quartzites, argillaceous quartzites and metargillites. Estimated thickness, 7,500 feet.
	Creston formation.—Grey-weathering, heavily bedded quartzites, argillaceous quartzites, and meta-sandstones separated by thin bands of metargillite. Estimated thickness, 9,500 feet.

Cambrian?—The boundaries between the three formations classed as Cambrian, cannot be fixed with any great precision, as the well-bedded rocks of these formations pass gradually and conformably into one another, and no fossils were found to aid in their stratigraphic division. The whole series is classed as Cambrian, though possibly belonging to the Pre-Cambrian. The presence of ripple marks, worm borings, and mud cracks in all of the sediments points to a shallow water origin.

The sills of diorite are numerous in the Creston and Kitchener formations, especially so in the latter. They seem to be absent from the Moyie formation, and, therefore, appear to have been intruded before the deposition of the Moyie beds. The sills sometimes attain a thickness of 400 feet, are more acid at their upper contacts, and become finer grained at both their upper and lower contacts.

Jurassic: Granite Intrusion.—On a lake situated at the head of the second creek on the south side of Baker creek, is an intrusive mass of granite (so-called in the field) which is badly smashed, and cuts the Moyie and Kitchener formations. The rock is of a grey colour, and varies from granitic to porphyritic in texture. The mineral constituents are quartz and biotite, with alkali and lime feldspars. Cutting this body are numerous fine-grained aplite dikes. As no younger formations are present, the age of this granite cannot be definitely determined, but is assumed to be Jurassic.

Pleistocene: Glacial and Recent.—Numerous records of glaciation are preserved throughout the region. All the lower hills up to the height of about 7,500 feet owe their rounded forms to the action of the Cordilleran glacier. In the higher mountains, glacial cirques containing small lakes may be seen at the headwaters of almost every stream. The valleys are all U-shaped, with meandering stream cutting channels in the flood plains. Hanging valleys characterized by falls are found on all the tributaries of St. Mary river. The direction of glacial striæ was noted in many places, but owing to the difficulty of discriminating between the striæ of the Cordilleran ice-cap and local glaciers, the direction of main ice movement is better determined from the erratics. The general direction seems to be from northwest to southeast.

The lower portions of all valleys are covered with a thick layer of glacial drift, thoroughly cemented by the solution and reprecipitation of calcium carbonate. This enables the drift to stand with steep cut banks, well shown along St. Mary river. The boulders found in the gravels consist of quartzite and diorite, and have not been transported far. More rarely, boulders of grey granite are found, which have probably been derived from a batholith situated about 20 miles northwest of the area examined. Near the present surface the gravels pass gradually into stratified clays and sands, which in the vicinity of the St. Eugene Mission contain two seams of lignite. The following section was measured:—

Eroded surface—	
Blue clay	4′–0″
Lignite	0′–6″
Blue clay	0′–6″
Lignite	0′–8″
Blue clay	2′–0″+

The lignite is brownish-black in colour, and crumbles easily. The seams are too thin to be of any economic value. Some of the clays are suitable for the manufacture of brick.

ECONOMIC GEOLOGY.

The Kitchener formation contains the majority of the metalliferous deposits. As noted above, this formation contains the larger number of gabbro-diorite sills. The examination of the mining properties and prospects was of necessity a hasty one. The deposits fall roughly under four heads: lead-zinc deposits, copper deposits, gold-quartz veins, and placers. The most promising ore-bodies are the lead-zinc deposits, of which the St. Eugene, North Star, and Sullivan are examples. These mines are located in the Kitchener quartzites.

The North Star mine is situated on the east slope of the North Star hill, in an area of disturbed Kitchener quartzites. These form the eastern limb of a huge anticline. They have a general strike of N 75° E (magnetic), and dip 10° to 25° S. The ore mined at present is purely the oxidized product of argentiferous galena and pyrite. It is brown in colour, earthy in appearance, and consists of limonite and cerussite (lead carbonate), with some native silver in moss-like aggregates. When the product of surface alteration has been exhausted the leaner sulphides—consisting of fine-grained galena, pyrite, and zinc blende—will have to be utilized. The hard ore contains very little gangue, and occurs on the axes and limbs of local anticlines, replacing the country rock which, near the vein, is altered to a white quartzite. The ore is mined by means of shafts, tunnels, and open-pits. Not enough work has been done up to the present to make possible any definite statement regarding the size of the deposit and its continuity in depth. The ore is shipped to Trail for treatment. About 25 men are employed, and the output for September, 1909, was 300 tons.

The Sullivan group of claims is fully described in the report of the Zinc Commission on the zinc resources of British Columbia.[1] At the time of the writere's visit, no work was being done on these claims, but since then the property has passed under the control of the Consolidated Mining and Smelting Company, and the output will be shipped to the Trail smelter. The lode is located in the Kitchener formation, on the southern slope of Sullivan hill. The strata in the vicinity of the mine have a general strike of N 50° E, and the dip varies from 10° to 25° S. About half a mile northwest of the mine a large diorite sill is intrusive into the sediments, and a sill of like character is to be found on North Star hill. The ore consists of very fine-grained galena, zinc blende, and pyrite, in intimate mixture. The percentage of zinc varies in different parts of the mine; and at present, the ore—which contains a large amount of zinc—is not utilized. The workings consist of a number of shafts, open-cuts, and one tunnel. These have not as yet exposed the size and relations of the deposit.

Pyramid basin contains a number of Crown-granted claims, and a considerable amount of work has been done; but most of the workings were inaccessible, owing to the filling of the shafts with water, and the caving of tunnels. On one claim, situated in the middle basin in the Kitchener formation, is a 2 ft. vein of arsenopyrite, galena, and pyrite, in a quartz gangue. The deposit is associated with a diorite sill, which has a dip of 50° S, striking N 50° E (magnetic). Situated on the west slope of Evans mountain, in an area of Kitchener rocks, is the Evans group of claims. On the lower claims a tunnel about 200 feet long has been driven into a low grade ore body, which consists of a coarse-grained gabbro-diorite, impregnated with pyrite, copper bearing in part, and pyrrhotite. The ore is found in the interior of a sill, and probably is of the nature of a differentiate. The upper claims have a fissure vein striking N 45° E, bearing chalcopyrite, pyrite, and native copper, in a quartz-calcite gangue. Pollen's claims, located near the above claims and probably in the same sill, contain a vein 8 feet wide, striking S 75° E. The ore consists of chalcopyrite, pyrite, copper-bearing in part, with very little gangue. A peculiarity of this deposit is the association of rather large crystals of pyroxene with the ore. A tunnel about 200 feet long has been driven to open up the deposit.

A number of claims were examined on Perry creek. The ore-bodies consist of quartz veins cutting across the Creston formation in various directions. No information could be obtained concerning these claims, but they were presumably located as free-milling gold propositions. Although no visible gold could be detected, values might be obtained by assay.

The only placer mining in the district is being carried on by the Perry Creek Hydraulic Mining Company, Limited, on Perry creek, about 4 miles above Old Town. Formerly the richest gravels close to bed-rock were worked over by means of tunnelling and sluicing. At present a hydraulicking plant, consisting of 3 miles of flume giving a head of 300 feet at the giant, and a sluice 550 feet long containing 250 feet of riffles, is in operation. The lower portion of the gravels is unsorted, and contains large glacial boulders of quartzite and gabbro-diorite. The upper part of the gravels consists of stratified clays and sands.

The future of the lead-zinc deposits in East Kootenay is dependent on the discovery of some method for separating the zinc mineral before smelting. The ore in the district consists of an intimate mixture of fine-grained galena, sphalerite, and pyrites, which is extremely difficult to separate. For a fuller discussion of the problem, the reader is referred to the report of the British Columbia Zinc Commission.

The copper deposits occur, so far as known, in the gabbro sills, which in the area examined never exceed 500 feet in thickness. Not enough work has been done to prove whether the veins occurring in these sills are continued into the quartzites above and below.

[1] Zinc Resources of British Columbia, and the conditions affecting their exploitation. W. R. Ingalls, 1905.

COAL FIELDS SOUTH OF THE GRAND TRUNK PACIFIC RAILWAY, IN THE FOOTHILLS OF THE ROCKY MOUNTAINS, ALBERTA.

(D. B. Dowling.)

INTRODUCTION.

The coal areas of Alberta, although known to be large in extent, are not all—owing to location or quality of product—available for supplying the coal required by the railways; consequently there is still a great demand for coal of the bituminous class, such as is found in the foothills and mountain areas. The areas containing such coal near the present railway lines are fairly well known, and are being exploited as fast as the demand warrants. The completion of the projected transcontinental railways through the Yellowhead pass will extend the market for coal so as to severely tax the producing powers of the present mines; hence, prospecting for coal in the vicinity of the projected lines has been very active.

The Bighorn coal basin, which was discovered in 1906, has been examined by Mr. Malloch of the Geological Survey, whose report will soon be issued. The report will deal with the exposures between the Saskatchewan and the Brazeau. The continuation of the area northward was hurriedly explored this season, and other exposures in the lower foothills were also examined. The results of this rough survey are shown on the small sketch map on page 144 of the present report. The general results of the exploration were the tracing of a long strip of coal-bearing lands reaching northward from the Saskatchewan to the sources of McLeod river, a distance of over 60 miles, and the locating of a smaller area east of Bighorn range. Another area lying in the outer foothills had been exploited previously, but the horizon of the coal was not known.

SUMMARY AND CONCLUSIONS.

South of the Grand Trunk Pacific Railway line, in the foothills, there are coal fields of large extent. Of these, the nearest to the railway is situated in the outer portion of the disturbed foothills area. From it, domestic, and a fair grade of steam coal may be obtained. The area is situated on the headwaters of Embarras and Pembina rivers, and may be of larger extent than outlined on the accompanying sketch map. Over a portion of this area a seam of from 12 to 17 feet can be mined.

Higher grade, steam and coking coals may be obtained from more distant fields, to which approach is more difficult, since they are situated behind high, rocky ridges. The areas containing the best grade of coal extend in narrow strips from the Saskatchewan river to near the Athabaska, behind the Brazeau, Bighorn, and Nikanassin ranges, respectively. The parts which seem mineable, and easy of approach through gaps in these ridges, may be outlined as: the Brazeau Range area, on the Saskatchewan; the Bighorn basin, from the Saskatchewan to the Brazeau rivers; and the southern part of the Nikanassin basin, drained by the McLeod and North branch of the Brazeau rivers. These areas may not be mineable outside a strip which is not much over a mile in width, but they have a total length of nearly 80 miles. A section of the measures near the Saskatchewan shows nearly 100 feet of workable coal, in about nine seams. Northward, the seams possibly decrease in thickness and number, but on the McLeod the upper part of the coal-bearing horizon was observed to have about 20 feet of coal seams. This may be added to by further prospecting.

The character of the coal is remarkably uniform; and in almost all parts of the field, coking coals that yield 75 per cent of coke may be found. The Fiddle Creek portion, at the northern end of the Nikanassin basin, has not been examined, but it is reported that coal has been found at points within half a mile of the Athabaska. Possibly there are anthracitic coals in this part of the basin, but the location of mineable areas is considered to be of more importance than the finding of harder coals.

GENERAL CHARACTER OF THE DISTRICT.

Topography.

The areas considered in this report as coal fields lie within the zone of disturbance on the eastern slope of the Rocky mountains, in the region generally described as the foothills, although including also spurs or short outlying ranges of mountains.

The Rocky mountains here consist of parallel ranges lying comparatively close together; but in the neighbourhood of the Saskatchewan valley, two outlying ranges occur in front of the masses forming the mountains proper. The outer one, Brazeau range, is cut transversely by the Saskatchewan valley, but extends only a short distance to the north of it.

Bighorn range occupies a position midway between Brazeau range and the mountains proper, but lies wholly north of the Saskatchewan, terminating toward the south, on the north side of the valley. The range parallels the Rocky mountains northward to Brazeau river, where it loses elevation, and ends. To the north, after a short break, another range continues to the Athabaska river, which it reaches between Drystone and Fiddle creeks. To this it is proposed to give the name *Nikanassin*, from the Cree words meaning 'outer range.'

The foothill region outside the true mountain areas, may—for descriptive purposes—be divided into two divisions: the rough foothills, and the undulating plateau country.

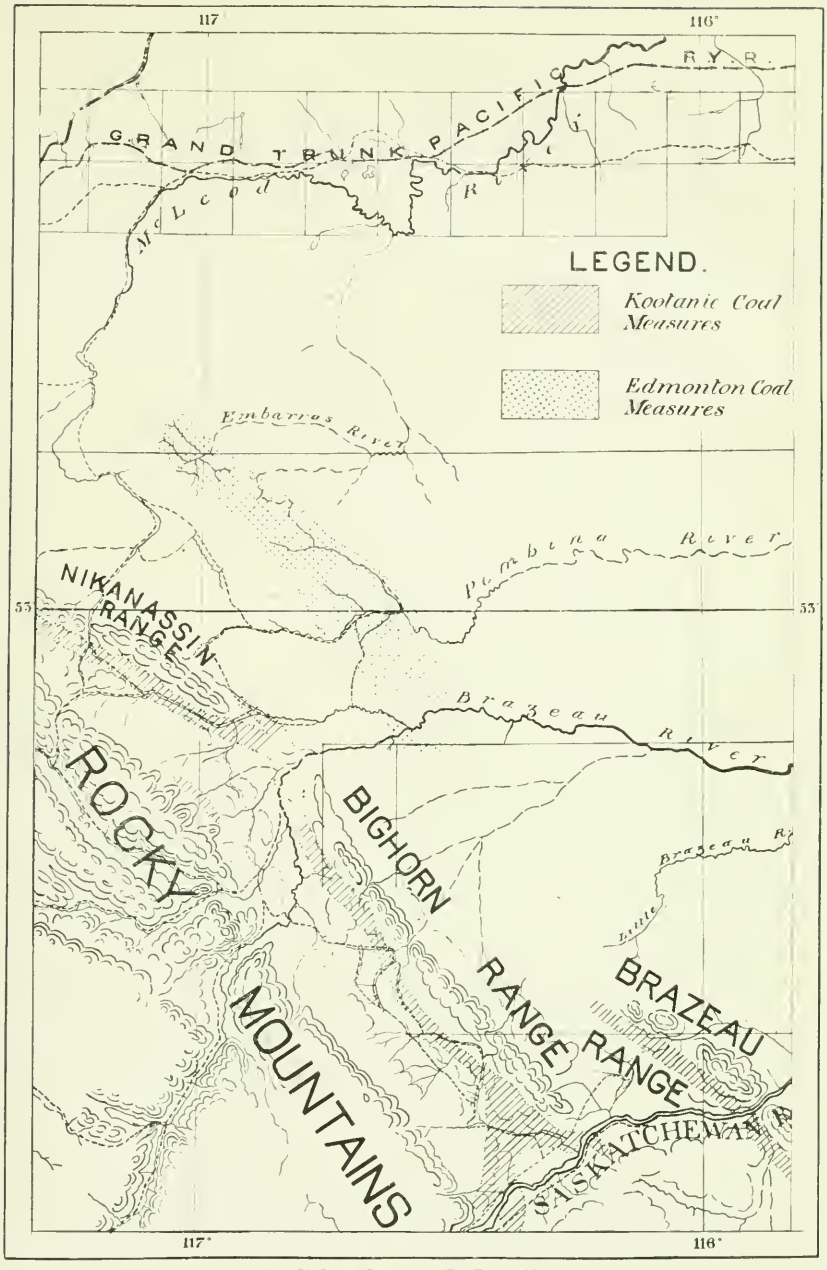
The rough foothills west of the McLeod river form a narrow belt as far south as Pembina river; from there, southward, the belt becomes wider, and the ridges more prominent, so that between Brazeau river and the Saskatchewan the foothills are arranged in very pronounced ridges parallel to the mountains.

The plateau country, bounded on the west by the rough foothills, merges easterly into the undulating country through which the Saskatchewan flows on its way to the more gently rolling prairie.

The greater part of the district drains easterly through the upper Saskatchewan, Brazeau, and Pembina valleys; but to the north there is a northward slope, drained by the McLeod and Embarras rivers.

Both the Saskatchewan and Athabaska occupy deeply-eroded valleys. In the neighbourhood of the mountains, the Athabaska seems to have reached, temporarily at least, a grade at which erosion is proceeding slowly. The Saskatchewan is still a swift stream, transporting a heavy load of coarse gravel, and at times of high water is muddy with finer debris. The Brazeau river, with its many branches, is of next importance, both in volume and extent of incision of its valley through the foothills and mountains. The main branch rises near the source of the Athabaska, although most of its water supply comes from glaciers, near Brazeau lake. Southesk river—the next branch in order of importance—rises near the head of the west branch of Rocky river, which flows into the Athabaska. The remaining tributaries of the Brazeau are the north and south branches, flowing from the outer ranges.

Pembina river is a foothill stream, and does not reach large dimensions within the area under consideration. McLeod river has no distinct valley through the Nikanassin range, its branches flowing northeasterly through several gaps in the range. These, after reaching a northward trending depression, unite to form the main stream.



COAL AREAS

IN THE FOOTHILLS BETWEEN

McLEOD AND SASKATCHEWAN RIVERS

ALBERTA

Miles 10 0 10 20 30 Miles

12507 -p 140. Fig. 2.

Forest.

The whole area may be classed as forested, although much of the forest has been destroyed by fire. Northward from Pembina river, one of these tracts of dead trees, burned years ago, covers a large area near the mountains. Between the Pembina and Brazeau the forest is still green, with local patches of dead timber. Near the Saskatchewan there is more open country, and the forested areas seem to be covered by younger trees, as though the forest was encroaching on former open country. Near the streams, spruce is the principal tree, but most of the hill forests are of Banksian pine, which, as it has a tall, straight, tree trunk free from limbs, is of value for use as timber where great strength is not required.

Transportation and Communication.

The projected railway is now graded from the east nearly to Wolf river, and rails are laid to Pembina River crossing. A road designed for wagons has been cut out almost to the mountains, but the western portion, owing to the swampy character of the ground, is probably impassable for wagons. Hence, the principal means of transportation during summer is by pack trains (horses) from the Pembina River crossing. Trails have been cut through the forest for freighting and by prospecting parties, in such number that now almost any point may be reached on horseback.

The main trails crossing the district from east to west are: (1) those following the location of the Grand Trunk Pacific railway; (2) trails along the base lines—the principal one being from Rocky Mountain house to the Bighorn range near the 11th base line; and (3) trails following the valleys of Pembina and Brazeau rivers.

The north and south trails leading from the railway line include those from Wolf creek to the mining camps on the head of Embarras and Little Pembina rivers; and another (not well travelled) from Prairie creek which joins a trail up the valley of McLeod river. The last named was the route traversed by Southesk when he penetrated the outer ranges to reach the headwaters of Rocky river. He entered the mountains proper by a stream which is the source of the north branch of the Brazeau.

The southern portion of the country shown on the sketch map can be reached from Laggan, Banff, or Morley, by following trails to the 'Kootenay plains' on the Saskatchewan, and thence north to the Brazeau by trails through the coal fields between the Bighorn range and the main Rockies. These trails are well travelled, and are on hard ground, so that they are preferable to the present approach from the east, which, in places, is through soft muskeg for considerable distances. Trails in a north and south direction in the foothills east of the Bighorn range are very ill-defined. Those shown on the sketch near the mountains are fairly well cut out.

Commercial Possibilities.

Better access to the district by the construction of railways and roads is all that is needed to ensure the opening up of important coal mines and the utilization of the timber resources. The Saskatchewan valley offers a good route for a railway; since the coal areas to be reached from it are extensive: as are also the agricultural and grazing lands on its slopes. To show that a branch railway up this valley need not be a mere spur line, it may be mentioned that the Howse pass, at the head of the valley, is reported to afford as feasible a route to the Columbia valley as that by the Bow and Kicking Horse river.

Surveys for railways into the Brazeau country are under way, and it is possible that a route through the mountains to Yellowhead pass may be found by the pass from Brazeau lake to the Poboktan; or, possibly, by the headwaters of Southesk river which heads with the west branch of Rocky river. No pass low enough to afford a

route to the valley of Maligne river was found; but connexion might be made by a tunnel through the dividing ridge at its narrowest point. The coal fields at the head of the McLeod valley could be reached by short branch lines up it, from the north.

The advent of railways will make available the excellent steam and coking coals of the Bighorn basin and its extension to the north.

GENERAL GEOLOGY.

The main ranges of the Rocky mountains are of the fault block type, with local folding or curving, in the vicinity of overthrust faults. These blocks in the outer ranges show a succession of beds ranging from reddish, sandy slates, of Triassic age, exposed on the western slopes of many of the hills, downward through massive Carboniferous limestones to the yellow tinted Devonian. The Bighorn and Nikanassin ranges are the upturned edges of such blocks; but on their western slopes there are found remnants of newer rocks, some of which are upper Cretaceous: for example, the sandy beds of the Belly River series.

The northeastward movement of the fault blocks of the Rocky mountains has in many cases caused an upturn of the beds in front, so that in the Bighorn basin the lower Cretaceous coal-bearing beds lying on the eastern ridges, reappear on the western edge of the fault block in highly tilted and often crumpled beds. In the field north of the Brazeau, this structure was not actually observed, but the presence of drift coal in stream beds in the centre of the belt indicates that the structure is probably similar to that in the Bighorn basin.

In the foothills immediately in front of the outer ranges, exposures of folded beds ranging downward to near the Dakota were observed on Pembina river. But to the east of the zone of disturbance, which was almost mountain building in its effect, there seems to be a fault running parallel to the mountains in the outer foothills, and beyond this line there is found the upper part of the Cretaceous—a great sheet of sandstones and shales of the Edmonton series, covered in some places, by Tertiary sandstones.

The areal distribution of the rocks in this district is greatly influenced by the faults and folds in the bed, which run northwest and southeast. If the formations were mapped they would be indicated, in many cases, by narrow bands having this direction. In a general geological description, the area may be conveniently subdivided into four divisions, which correspond more or less closely to those given under the topographical description. The sequence of formations is given from east to west:—

(1) The plateau country having exposures of upper Cretaceous, and probably some Tertiary beds.

(2) A foothill area made up of Cretaceous rocks, ranging in age from the Dakota to the Belly River, with lower Cretaceous beds upturned in places at the base of the first limestone ridge.

(3) An inner belt of foothills behind a barrier of limestone (Triassic to Devonian in age), having exposures of Cretaceous beds ranging from the Kootanie upward to the Belly River formation.

(4) The mountains proper, showing narrow bands of rocks which repeat the succession from the Devonian to the Triassic.

The formations bearing coal in economic quantities are only two: the Kootanie, and the Edmonton; only thin seams of coal, a few inches thick, are found in the Belly River rocks. The Kootanie, which in the type locality is believed to be of fresh water or inland origin, in this district is of a character that seems to indicate that, during its deposition, the land was low enough to allow the water of the sea to occasionally flood at least the northern portion. At the northern outcrop of the rocks of this formation, coal seams are probably fewer than farther south, and confined to the top of the formation.

Structure.—The first great fault along which the lower Cretaceous beds are brought into contact with the younger measures which cover the eastern slopes of the foothill area, is found near Miry creek in the foothills, in front of the Brazeau range. Northwestward, this fault crosses Pembina river 6 or 8 miles west of Little Pembina river, and continues to the head of Prairie creek on the south bank of the Athabaska. Northward from this point it follows the edge of the mountains. The next important break occurs in front of the Bighorn range; and, with some complexities near the Brazeau river, continues northward and crosses the Athabaska at Drystone creek. Between these two breaks the rocks are folded into a trough or syncline, followed west and southwest by an anticline. Throughout the foothills these folds are not greatly compressed; but near the Athabaska river, where the axes of the faults are quite close together, the beds dip at high angles.

The upward displacement of this fault block between the above two main faults, becomes greater toward the north, where the appearance at the surface of pre-Cretaceous, hard limestones marks the beginning of another range. The syncline decreases in importance northward, and the crown of the anticline, in the narrower part of the block, forms the centre of the ridge. This feature is shown in the mountain called Folding mountain at the Athabaska, where the beds exposed are of Carboniferous limestone capped by Triassic and Jurassic beds.

The next fault block is bounded on the east by the westernmost fault above mentioned, and on the west by another which extends along the base of the main Rockies from the Saskatchewan to the north branch of the Brazeau, where it enters the mountains, reaching the Athabaska west of Fiddle creek. The block included between these two fault lines has been uplifted, and its eastern edge uptilted on the block to the east. The lowest beds exposed along the eastern edge are limestones of Devono-Carboniferous age, overlain, except where erosion has removed them, by Triassic, Jurassic, and Cretaceous beds. The western edge has in some places been overridden by the next succeeding blocks of the mountains proper, but in most places the softer Cretaceous beds are buckled back, and in places the block forms a trough with steeply upturned beds along its western border. Where the lateral boundaries approach one another, as they do in the mountains, the block is tilted steeply to the southwest, and the Cretaceous coal-bearing beds will probably be found to show the effects of pressure and folding.

ECONOMIC GEOLOGY.

General Character of Coal.

The coal of the Kootanie measures in the Bighorn basin has been carefully examined by several prospectors, and analyses have been published in the Summary Reports for 1907 and 1908, which show that it is a bituminous, or steam coal, with a high carbon content, not generally high in ash, and always low in sulphur. Practical tests with a small coke oven on Bighorn river show that a very high grade of coke can be made. Northward, in places, the fixed carbon content is higher, but it seldom approaches that of an anthracite coal.

The coal of the Edmonton measures in the foothills on Pembina and Embarras rivers is of lower carbon content, and approaches what might be termed a low carbon bituminous coal. Its coke is not as firm as that from the coal fields nearer the mountain. This might be expected, as the measures are younger and have not been subjected to great pressure. The results of analyses of these coals from individual exposures will be found on a subsequent page.

Distribution.

In the Kootanie measures the coal seams found near the Saskatchewan are well distributed throughout the formation. There appears to be in nine seams a total thickness of 90 feet of workable coal. On George creek—one of the forks of the south

branch of Brazeau river—Mr. McEvoy found ten seams, with 65 feet of workable coal. Near the north end of the range on Wapiabi creek, Mr. Malloch last year discovered four seams near the top of the formation, with about 26 feet of coal. On the north branch of the Brazeau, four seams are exposed in the same part of the measures; and on McLeod river the coal is apparently all in the upper measures.

In the upper part of the Cretaceous, as exposed in the foothills on the Embarras and Little Pembina rivers, the coal seams occur in the Edmonton formation—the horizon in which the Big coal seam on the Saskatchewan, and that at the railway crossing on the Pembina occur.

Details of Exposures.

Northern end of Bighorn Basin.—In the Brazeau valley few exposures have been found, but it is certain that the Coal Measures continue across the valley following the direction of the ridges. Several small streams drain southwestward from the Bighorn range to the Brazeau, and on these exposures of the underlying rocks will probably be found. One such stream visited this season, and provisionally called Race creek, crosses the line between ranges 19 and 20, through section 6 of township 43, range 19. Near the eastern edge of the section there exposed, two coal seams are visible: an upper one of 4 feet, and a lower one of 5′–8″. Both seams are mineable, and appear to be good steam coals, but are not certainly known to be coking coals. The analysis of the heavier seam, by Mr. Wait of the Mines Branch, Department of Mines, shows:—

Moisture	1·64
Volatile combustible matter	21·14
Fixed carbon	70·08
Ash	7·14
	100·00

Coke, coherent, but tender.
Colour of ash, white, inclining to grey.

Other seams may probably be found by trenching, since the measures are concealed over long strips by a clay and gravel covering.

On the main Brazeau, coal seams are reported to occur near the mouth of Southesk river. This part of the valley, owing to the thickness of the river deposits, will require careful examination to determine the limits of the field.

North Branch Brazeau River.—The north branch of Brazeau river rises in the outer ranges of the Rocky mountains in two well-defined valleys that join at the eastern edge of the northern coal field. The stream, a short distance below the junction, crosses a fold east of the fault which brought up the ridge to the north, and this fold may represent a continuation of the Bighorn basin. On the south fork the stream crosses the measures nearly at right angles, and several exposed coal seams have been prospected. In descending the stream from the trail crossing, the shales of the Colorado group are found dipping toward the mountains or to the southwest, at angles increasing from 20° to 40°; then sandstones are encountered, supposed to be of the Dakota formation, though the line of demarcation between them and the underlying Kootanie is not apparent. These sandstones are not over 500 feet thick, and coal seams occur just beneath them. The first or upper seam dips nearly south at an angle of 55°, and has a thickness of 10′–5″ (including 8 inches of dirty coal occurring in two streaks near the middle of the seam). An analysis of samples taken across the seam shows it to be a good quality steam—probably coking—coal. The results given by Mr. Wait are:—

Proximate analysis by fast coking—

Moisture	1·22
Volatile combustible matter	22·11
Fixed carbon	69·06
Ash	7·61
	100·00

Coke, firm, coherent—76·67.
Colour of ash, reddish-brown.

Ten feet below this seam a 4 ft. seam may be mined, but the outcrop does not promise well, the coal being very dirty. On the south bank, a few hundred feet below the top seam, a 6 ft. seam of good coal occurs, but there is a local fault in the measures, and the coal may be too much crushed to mine. Below the middle sandstone rib on the south bank, an 8 ft. seam which dips at a steeper angle to the southwest, appears to be unbroken, and is probably a good mineable seam; 2 feet at the bottom is dirty, but the upper 6 feet is of bright, clean, steam coal, and probably a good coking coal. The analysis shows an especially low ash content. Analysis by Mr. Wait:—

Proximate analysis by fast coking—

Moisture	1·42
Volatile combustible matter	23·76
Fixed carbon	70·50
Ash	4·32
	100·00

Coke, firm, coherent—77·82.
Colour of ash, light brown.

Below the confluence of the two forks a few seams of coal are exposed in an anticline of the Kootanie rocks opposite Cardinals grave at the Prairie camp, where the trail to Pembina river turns northward from the north branch of the Brazeau. No prospecting has been done on the measures here, so that very few coal seams have been found, but a group of four seams, close together, is known to occur near the top of the formation, with thicknesses of 2, 3, 3, and 4 feet respectively. These, with a 5 ft. seam, are probably repeated to the east at the narrow cañon, since seams having corresponding thicknesses are found there. A sample from the lower 3 ft. seam, which looked the brightest coal, is certainly of a high grade, judged by Mr. Wait's analysis:—

Moisture	0·66
Volatile combustible matter	24·52
Fixed carbon	70·86
Ash	3·96
	100·00

The north fork of the North Brazeau runs for a long distance parallel to the outer limestone ridge of Nikanassin range, but the exposures are mostly of the lower part of the measures, and show thin coaly streaks only. Considerable faulting and slipping of the beds on one another is apparent, but the hills to the west bordering the valley may contain workable seams. The upward continuation of the stream crosses the measures, but exposures of coal seams were not seen.

Continuing northwesterly along the strike of the rocks after leaving the waters of the Brazeau, the drainage is northward. Streams from the mountains cross the

Nikanassin range through three gaps, joining outside to form the McLeod river. On the first branch north of the Brazeau, exposures of coal seams were staked by Thos. Russell in 1906. A thick seam near the stakes measures 12 feet, and the weathered coal sampled across the section (including dirty coal) shows, on analysis, high ash, but remarkably low fixed carbon.

Analysis by F. G. Wait, of coal from 12 ft. seam, Russell claim, head of McLeod river, township 46, range 23, west of the 5th meridian:—

Moisture	5·79
Volatile combustible matter	22·68
Fixed carbon	50·97
Ash	20·56
	100·00

Coke, non-coherent—71·53.
Colour of ash, light brown.

Below this seam, near the creek bed, a small, clean-looking coal seam 2′–3″ in thickness was also sampled for comparison, in order to determine if the beds were changing in general character. This coal is of the same general grade as those to the south, giving the following results:—

Moisture	1·18
Volatile combustible	21·46
Fixed carbon	73·10
Ash	4·26
	100·00

Coke, firm, coherent—77·36.
Colour of ash, bluish-grey.

Several small seams were found in the same creek below the large one mentioned, but were all too small to work.

In the third opening, through which the largest branch issues, the measures were found and reported on by R. W. Jones, C.E., whose samples were analysed by Mr. J. O'Sullivan, provincial assayer for British Columbia. A seam, which is perhaps a continuation of the 12 ft. Russell seam, but measures 7′–6″, gave the following analysis:—

Moisture	1·0
Volatile combustible	27·5
Fixed carbon	56·5
Ash	15·0
	100·0

Coke, hard and firm.

Another, with a thickness of 4′–6″, is of better quality both in respect to ash and fixed carbon content, having:—

Moisture	1·5
Volatile combustible	30·5
Fixed carbon	61·5
Ash	6·5
	100·0

Coke, hard and firm.

This series of coal-bearing rocks extends into the mountains and continues on, west of the Nikanassin range, to the Athabaska; but the basin appears to be narrower, owing to the convergence of the fault lines between which it lies. In this area of great pressure and folding, coals may be found, having anthracitic characteristics.

Brazeau Range Coal Basin.—Exposures on Miry creek show that another belt of Kootanie rocks crosses the valley of the Saskatchewan east of the Bighorn range. These rocks were not critically examined owing to lack of time, and no coal seams were discovered in them, but no doubt seams will be found in them when the construction of a railway line up the valley is begun.

Pembina and Embarras Coal Field.—The coal seams on the Little Pembina seem to occur at about the horizon of the top of the Edmonton formation, like the thick seams at the railway crossing on the main river.

The valley of the Little Pembina seems to follow a line of fracture, from which the loose material has been removed; the exposures near its mouth on the Pembina river show this, and also those at the prospecting camp, where a 12 ft. seam in one place is found buckled back, so that the face of the bank shows an exposure of broken coal 25 feet between the walls. At other points, not visited, it is reported, though the reports are probably exaggerated, that local swells in the seams give thicknesses as great as 42 feet. The thickness of the undisturbed seam does not appear to be less than 12 feet, and in places increases to 17 feet. This coal, which has been altered by pressure to a coal of the bituminous class, may fall below that class in its undisturbed portions. A sample from the 25 ft. exposure gave the following analysis. (It is tabulated for comparison with one from the undisturbed coal seam nearby.)

	35 ft. mass.	12 ft. seam.
Moisture	4·32	6·32
Volatile	33·52	35·71
Fixed carbon	57·02	52·25
Ash	5·14	5·72
	100·00	100·00

The area underlain by this seam appears to be large, since the beds dip gently to the west; it would seem advisable, therefore, to test the ground by boring before mining operations are actually begun. The lease for this area is held by the 'Pacific Pass Coal and Coke Company,' who are prospecting on the Little Pembina.

Another Company, 'The Yellowhead Pass Coal and Coke Company,' has under lease an area in townships 48 and 49, ranges 20 and 22, west of the 5th meridian, on the upper waters of Embarras river. Extensive prospecting operations have been carried out this year under the general charge of Mr. F. B. Smith, from whose report the following notes were obtained:—

The coal field forms the southwestern portion of an anticline, the crest of which is to the northeast of the property. The strike of the beds and the outcrop of the seams run in a northwest direction. The dip of the beds near the crest of the anticline is about 55° from the horizontal. To the southwest the upper members of the series have gentler dips, and are, consequently, less disturbed.

Two heavy beds or deposits of coal are found, separated by 1,500 feet of sandstones and shales. The lower one shows in places a great thickness of coal; but is so impure that without special means for cleaning or washing, it would not be all available. Its greatest thickness is found east of the outcrop near Embarras river, where it shows about 36 feet of coaly beds forming two benches: an upper one of 24 feet separated by 2 feet of shale from the lower 12 ft. bench; it probably thins out materially toward the edges of the field.

The upper heavy deposit or series of seams is found distributed through from 50 to 100 feet of beds. The prospecting on this, at points distributed over a distance of 3½ miles of outcrop, shows a coal content of 35 feet, occasionally increased to 50 feet. Of this coal, two benches seem to be fairly constant, with 9 feet of coal in each. Other seams at the centre of the section may in places allow of an additional amount being included in the estimate of workable coal.

The character of the coal from the upper part of this series of seams may be seen from the following analysis made for the Company by the Milton Hersey Company, Limited:—

Prospect opening B 3, upper bench coal 9′–6″.—

Moisture	8·42
Volatile combustible matter	38·88
Fixed carbon	45·50
Ash	7·20
	100·00

Heating value in B.T.U.—10·982.

The coal from the lower part of this horizon was also sampled in the same locality, from a 7 ft. bench—the upper part of a lower seam, which is here about 17 feet in thickness. The analysis was also by the Milton Hersey Company:—

Prospect opening B 3, lower bench.—

Moisture	5·40
Volatile combustible matter	37·17
Fixed carbon	49·33
Ash	8·10
	100·00

Heating value in B.T.U.—11·957.

These two analyses show the lower coal to be decidedly superior to the upper.

Other Reported Areas.—It is quite possible that an extension of the seams described above may be found on McLeod river. The character of the coal is, however, not of sufficiently high grade to place it in serious competition with that obtainable near the mountains. Along the projected railway, coal of lower grade has been found in several places. Brief descriptions of these, with analyses, follow.

An 8 ft. seam is exposed on a branch of Prairie creek which is crossed by the railway just below Brulé lake on the Athabaska river. It gave the following analysis—an average of three samples:—

Moisture	10·10
Volatile combustible matter	37·54
Fixed carbon	45·07
Ash	7·29
	100·00

A smaller seam in the same locality, 2′–3″ in thickness, and hardly workable, had:—

Moisture	4·80
Volatile combustible matter	33·20
Fixed carbon	43·10
Ash	18·90
	100·00

Several seams outcrop on the Athabaska river, above the mouth of the McLeod. An outcrop near the mouth of Oldman river is reported to be of workable thickness, and a sample received from there is superior to the average from this locality. The sample is apparently a coking coal, or very nearly approaches one. Analysis by F. G. Wait:—

Moisture	6·97
Volatile combustible matter	37·85
Fixed carbon	48·77
Ash	6·41
	100·00

Coke, firm, coherent—55·18.
Colour of ash, brown.

On the Athabaska, 20 miles above the mouth of the McLeod, two seams are known that are 10 feet and 3 feet, respectively, in thickness. The following analyses are from Geological Survey Reports:—

Thickness of seam	10′–0″	3′–0″
Moisture	11·47	10·58
Volatile	32·09	32·79
Fixed carbon	47·79	50·19
Ash	8·65	6·44
	100·00	100·00

Samples sent in for examination from seams near the railway, the thicknesses of which were not given, gave the following analyses, from which their character may be inferred:—

McLeod river, near railway. Sample contained:—

Moisture	9·47
Volatile combustible	39·24
Fixed carbon	48·25
Ash	3·04
	100·00

A sample from Jocks crossing contained:—

Moisture	10·21
Volatile combustible	38·17
Fixed carbon	43·52
Ash	8·10
	100·00

A sample from near Wolf creek, in township 52, range 15, west of the 5th meridian, contained:—

Moisture	8·57
Volatile combustible	40·39
Fixed carbon	46·74
Ash	4·30
	100·00

These samples are very little higher in fixed carbon content than the coal from the railway crossing of the Pembina, the general character of which is indicated by the following analyses of two seams, exposed in the banks:—

Thickness of seams	13′–0″	6′–0″
Moisture	13·78	13·07
Volatile combustible	32·01	32·03
Fixed carbon	47·35	47·56
Ash	6·86	7·34
	100·00	100·00

Kootanie Coal Measures in Smoky River Basin.

Samples of coal, with a few fossils, were submitted by Mr. J. R. Akin, from exposures on branches of Muskeg river, in sections 2 and 4, township 57, range 7, west of the 6th meridian.

The fossils (a few leaves and bivalve shells) are identified by Mr. F. H. Knowlton, of the United States Geological Survey, as being *Zamites acutipennis*, Heer, a plant of the Kootanie formation. The shells are a marine genus, *Tancredia*, found also in the Jurassic. The analysis of one of the samples of coal by Mr. F. G. Wait shows that it is similar in character to that in the Brazeau field, having:—

Moisture	1·22
Volatile combustible	24·38
Fixed carbon	68·67
Ash	5·73
	100·00

Coke, firm, and coherent—74·40.

Several seams are reported, but there appears to be on each section a seam between 8 and 10 feet thick, in beds inclined at about 45° to the horizontal. This occurrence is possibly the southern end of a large area which crosses the Peace river in the vicinity of the mountains.

General Development.

Although considerable expense has been incurred in the purchase and rental of lands, as well as in location surveys, active work in the line of testing the seams has been confined to sending out small parties during the summer months to do excavating by hand. In the Bighorn basin, the seams are fairly well known, and have been reported on. A small coke oven was built on Bighorn creek, and the coke produced was of the best class.

On the Little Pembina, the Pacific Pass Coal and Coke Company have built several small houses, and maintain a staff of prospectors to open the seams of that neighbourhood. The Yellowhead Pass Coal and Coke Company, on Embarras river, have also established a camp on their holdings.

LAC LARONGE DISTRICT, SASKATCHEWAN.

(William McInnes.)

DISTRICT EXPLORED.

The district explored lies in the northern part of the Province of Saskatchewan. It embraces the country in the neighbourhood of Lac LaRonge, including Nemeiben or Sucker lake to the west, Wapawekka lake (Bear or Pipe lake) to the east, and a part of Churchill river to the north.

Micrometer telescope surveys were made of Lac LaRonge, including the large expansion to the east known as Trout lake, but exclusive of the west shore and adjoining islands, which were being surveyed by L. R. Ord, D.L.S., for the Surveys Branch of the Interior Department; Wapawekka lake; Rapid river and lakes; and a chain of lakes forming a portage route between Lac LaRonge and Stanley.

PREVIOUS WORK.

The region was visited by D. B. Dowling in 1892, who published a brief description of the lake in Vol. VIII of the Geological Survey reports, pp. 101-102 D; and by the writer in the autumn of 1908 (see Summary Report of the Geological Survey of that year, pp. 80, 82).

The exploration of 1909 was undertaken primarily for the purpose of ascertaining the value of the minerals of the district. Thomas Firth, B.A., acted as assistant, and performed the duties required in a most satisfactory manner.

SUMMARY AND CONCLUSION.

A series of rocks resembling in many respects the Grenville series of eastern Canada, and which, for convenience of reference, is called the Lac LaRonge series, was found, in certain bands, to be impregnated with sulphides. Many locations have been staked on bands of this description both on Lac LaRonge and on Churchill river, and a little assessment work has been done on some of them. The result of assays of material taken from typical locations has been uniformly disappointing.

At the southern end of Lac LaRonge, the Pre-Cambrian rocks are overlain unconformably by limestone of Devonian age; and farther east, along the south shore of Wapawekka lake, by Cretaceous sediments, thought to be of Dakota age. The Cretaceous is made up in the main of white quartz sands and sandstones, very free of impurities, and well adapted for the manufacture of glass. They contain also a bed of lignite that, where exposed on the shore of the lake, has a thickness of 29 inches of clean coal.

GENERAL DESCRIPTION.

Topography.

The country is a gently rolling, profoundly eroded plateau region or peneplain, lying at an elevation of about 1,200 feet above the sea. It is intersected by many streams and lakes that occupy only moderate depressions in the surface. Excepting in the south, where newer sediments overlap the ancient land surface and the Wapawekka hills form a conspicuous ridge 800 feet or more above the general level, there are no prominent elevations. The general drainage is northward and eastward to Hudson bay. The most important watercourse is the Churchill river, which flows

easterly through the northern part of the area. In this part of its course, 600 miles or more from Hudson bay, it is already a river of large volume, flowing like most of the rivers draining the great Pre-Cambrian peneplain, through a series of wide, irregular, lake-like expansions connected by short rapids and falls. Rapid river, the outlet of Lac LaRonge and its upward extension, Montreal river, drains the greater part of the district, flowing northerly into the Churchill river. The water of Wapawekka lake flows easterly into Pelican lake and reaches the Saskatchewan river by way of Sturgeon-weir river.

The river valleys of the old, Pre-Cambrian peneplain occupy pre-glacial depressions in the rock surface; the valley of the Churchill river is an instance in point, the river flowing over the rims of succeeding rock basins with little erosive effect. On the other hand, the river valleys of the southern part of the area are now in course of very active erosion by the rivers that occupy them. Montreal river is a good example of a river flowing in such a valley, showing, as it does, at a number of points along its course, high scarped banks where widening of the valley by the undermining action of the current is progressing at a rapid rate.

Transportation.

The district can be reached in summer only by canoe routes, of which there are two principal ones: one from Prince Albert, by an 80 mile portage to Montreal lake and down that lake and the river flowing from it, a distance of 125 miles or more, to Lac LaRonge; the other from The Pas, the present terminus of the Hudson Bay branch of the Canadian Northern railway, by the Saskatchewan, Sturgeon-weir, and Churchill rivers. In winter, when it is most easily accessible, the district may be reached by a sleigh road about 160 miles long. Over this route the fur companies do most of their freighting. A branch of the Canadian Northern railway, now building northwesterly through the settlement on Shell brook, will shorten the distance by only a few miles.

Commercial Possibilities.

A considerable area of good agricultural land is crossed by the road leading from Prince Albert to Montreal lake, a continuation eastward of the area of such land traversed by the railway along Shell brook. To the north, throughout the whole region about Lac LaRonge and the Churchill river, the areas of good land are not of great extent, the larger part of the surface being either too sandy or too rocky for general cultivation. Limited areas, chiefly about the northeastern part of Lac LaRonge and along the Churchill river, have a surface cover of clay that provides a fair soil for agriculture.

Climate.

Though the winters are long and severe, the summer temperatures are relatively high, and the hours of possible sunshine long in this high latitude: about 180 hours or ten days (reckoned in sunshine) longer than in central Ontario during the months of June, July, and August. For this reason the seasons are quite long enough for the ripening of grain crops. On August 7, at Stanley, on the Churchill river (N lat. 55° 25′), potatoes were in full flower, and small fields of wheat, barley, and oats, planted about May 20, were well grown; the wheat stalks averaged 30 inches in height, and the grain was in the milk and beginning to harden. About August 20, a good crop of wheat and oats was harvested from a small area under cultivation at the Anglican mission on Lac LaRonge. At both places good garden vegetables of the ordinary kinds were successfully grown.

Fauna and Flora.

Large game is not plentiful in the immediate neighbourhood of Lac LaRonge. In the country to the south of the lake, however, where the browsing is better, moose are numerous; while about Red Deer lake and in the country to the south of it Virginia deer are found. The common fur-bearing animals of northern Canada occur throughout the district, and ducks of various kinds breed about the lakes and ponds.

Fish are abundant throughout the region: lake trout and whitefish of good size and quality are plentiful in Lac LaRonge, and whitefish in Churchill river and its lake expansions; while pike of good size occur in all the lakes.

The larger trees occurring in the district are white, black, and balsam spruces (the first named constituting the lumber tree of the district); tamarack; Banksian pine; aspen and balsam poplar, and white birch. Ash-leaved maple grows as far north as the south shore of Lac LaRonge.

The greater part of the region has been repeatedly burned over, only a few islands and small local areas having escaped. The largest of these unburnt areas lies to the south of Lac LaRonge and east of Montreal river, where large white spruces cover a belt extending south from the lake shore.

GENERAL GEOLOGY.

The greater part of the region under consideration is underlain by the very old rocks of the pre-Cambrian complex. They consist of biotite gneisses of various kinds; crystalline limestone; chloritic, hornblendic, and other schists; diorites; diabases, etc.; with many intrusive masses and dikes of pegmatite and granite. Though over certain areas, notably on the eastern shores of Trout bay, the fine gneisses, associated with sill-like bands of coarse gneiss and pegmatite, lie in a gently undulating attitude, yet over the greater part of the area, they dip at high angles and preserve a very uniform northeasterly strike. Lying on the upturned, profoundly eroded edges of the old schists and gneisses, in the southern part of the area, are two series of newer sediments. On the north shore of Lac LaRonge these consist of fossiliferous, magnesian limestone of Devonian age; while farther east, on Bear lake, lignite-bearing sands and sandstones of Cretaceous age directly overlie the Pre-Cambrian.

TABLE OF FORMATIONS.

Quaternary—

Recent:—Lacustrine clays, sands, and river sands and gravels.

Pleistocene:—Morainic boulder ridges and erratics.

Mesozoic—

Cretaceous—

Dakota:—White quartz sands and sandstones, with lenticular beds of quartzite grit and conglomerate (lignite bearing).

Palæozoic—

Devonian:—Buff-coloured magnesian limestones, sandstone and conglomerate (fossiliferous).

Pre-Cambrian—

Lac LaRonge Series:—Fine biotite gneisses, augen gneisses, quartz schists, crystalline limestone, etc.

Keewatin:—Chloritic and hornblende schists, diorite, diabase, etc.

Laurentian:—Biotite, granite gneisses.

Igneous—

Biotite granite and pegmatites.

Diorite.

Pre-Cambrian and Igneous.

Rocks of Pre-Cambrian age underlie the greater part of the shores of Lac LaRonge and its many islands. They consist, in the main, of a series of gneissic and schistose rocks, all greatly metamorphosed, and showing the effects of pressure and shearing. Biotite-granite gneisses are exposed over a considerable part of the area, and infolded with them are fine, banded and stretched 'beaded' biotite gneisses (see illustration, page 102 D, Vol. VIII, G.S.C.); augen gneisses; quartz schists, in places calcareous; and crystalline, white magnesian limestones. The limestones form a band, 1 to 5 chains wide, conforming in dip and strike to the general trend of the gneisses. The band is made up of magnesian limestones of varying purity, all of which are quite crystalline in structure. All about Lac LaRonge the dips keep a very regular northwesterly direction and high angle, reversing along the east shore to southeasterly, and becoming, still farther east, horizontal or undulating. There is evidence to show that some of the folds are overturned, so that in a section across the strike there is a repetition of the strata.

The general lithological resemblance of this set of rocks to the Grenville of eastern Canada is strong, and the occurrence in them of white crystalline limestone, quite similar in character to the bands of that rock in eastern areas, makes the resemblance more striking.

On Wapawekka lake, a series of diorites and schists of various kinds, that can with some certainty be referred to the Keewatin, appears as a broad belt, emerging from beneath the flatlying sandstones of the Cretaceous and trending almost due east. This is the fifth belt of such rocks now known to occur, between Lake Winnipeg and Lac LaRonge, in this relationship: namely, protruding from underneath the overlapping sedimentary cap and rapidly tapering to extinction in the gneisses. Small boss-like and lenticular areas of diorite and schist, resembling the Keewatin lithologically, occur at other points, in the area mainly covered by gneisses.

Igneous.

Red granite made up of quartz, orthoclase, feldspar, and biotite mica, generally rich in quartz and poor in mica, and varying in grain from coarse to fine, outcrops over a considerable area along the eastern part of Wapawekka lake. Pegmatite invades the fine gneisses, as dikes, sill-like bands, and irregular masses almost everywhere. Diorite, in a few places, invades and sends apophyses into the fine gneisses.

Devonian.

No strata of this age were found that were certainly in place, but the occurrence along the south shore of Lac LaRonge of large angular blocks of buff-coloured magnesian limestone or dolomite, with fossils that indicate Devonian age, leads to the belief that they are in place immediately below. The debris of this limestone, mingled with blocks of buff-coloured, calcareous sandstone, and angular pieces of a conglomerate holding pebbles of limestone and quartz cemented by a calcareous arenaceous paste, occurs at some points in such quantity as to make up the whole shore, to the total exclusion of other rocks. Fossils collected from these rocks are thus described by Mr. Lambe of this department:—

'The Lac LaRonge fossils consist of mature and immature specimens of *Atrypa reticularis* L., and of portions of the stems of crinoids. Some of the mature specimens of the brachiopod show the "marginal fringe" so well preserved in a number of examples of this species from the dolomites of the Winnipegosis district. The fragments of crinoid stems agree in form with those, from the Winnipegosis region, referred by Dr. Whiteaves to a species of Ctenocrinus. They are of Devonian age, at about the horizon of the "Stringocephalus zone" (middle Devonian).'

Cretaceous.

Along the south shore of Wapawekka lake are scarped banks of white quartz sands, in places coherent enough to form a sandstone.

Though no fossils were found in these rocks, they are assigned, with some degree of confidence, to the Dakota division of the upper Cretaceous, from their strong lithological similarity to strata of this age elsewhere, together with their stratigraphical relationship to the older rocks.

Pleistocene.

The only deposits in the district that can be assigned this age are morainic ridges of boulders, in the southern part of the area; and erratics, scattered everywhere over the Pre-Cambrian peneplain. The region has been strongly glaciated, mainly by a glacier moving in a direction S 30° W as indicated by 'crag and tail' surfaces, chatter marks, and the prevalent striæ. This direction is quite in accord with the generally accepted idea of the direction of movement of the Continental glacier. Not so easy of explanation are other striæ, strong, and marking well the direction of the ice sheet producing them, that are found both at the shore and on neighbouring hills, near Trout narrows, on the east side of Lac LaRonge. Their direction is S 45° E, and they plainly override an earlier, southwesterly glaciation.

Post-Pleistocene.

The entire southern part of the district between the south shore of Lac LaRonge and the North Saskatchewan river is covered by heavy deposits of post-Pleistocene sands and clays.

Sections of a part of the sands are seen in scarped banks along the course of Montreal river. These show 40 feet of finely-laminated, horizontally-bedded sand, succeeded by 10 feet of sand characterized by very marked false bedding, where the stratification is contorted in a most intricate manner, overlain by 15 feet of fairly regularly stratified sand, extending to the present, plateau-like surface.

Beds of river silt and sands, made up of rearranged material derived from the sands just referred to, are being laid down in the valley.

ECONOMIC GEOLOGY.

Certain bands in the fine gneisses and schists of the Pre-Cambrian of Lac LaRonge and the Churchill river, are richly mineralized with sulphides of iron, and sparingly with copper sulphides. In the Summary Report of the Geological Survey for 1908, the results of six assays of material from these localities were given. None gave more than traces of gold or nickel. It was then stated that, so far as observed, copper had not been found in sufficient quantity to be commercially valuable. Observations made this summer have served to confirm the opinion then expressed. The results of assays of material taken this summer from two locations on Lac LaRonge and from two on Churchill river are no more promising than those of last year. The assays were as follows:—

LABORATORY OF MINES BRANCH, DEPARTMENT OF MINES.

No. 1477. Quartz from Bearcave hill, Churchill river:—
Gold..... trace.

No. 1478. Siliceous rocks from Churchill river below the mouth of Rapid river:—
Gold..... trace.

MILTON HERSEY CO., L 15, MONTREAL.

Certificate of assay of two samples:—

No. 7 (sample from north end of Mineral island, Lac LaRonge):—

Gold	trace.
Silver	none.
Nickel	trace.

No. 8 (sample from near south end of Mineral island, Lac LaRonge):—

Gold	trace.
Silver	none.
Nickel	none.

It may be said then, that exploration in the district, so far, has not yet resulted in the finding of copper in commercial quantity; and that the sulphide-bearing belts on which most of the locations have been staked, do not promise to yield either gold or nickel in payable quantity.

A little assessment work was done on a few properties on Lac LaRonge, and a shot or two put in on Churchill river; but, with these exceptions, no actual mining has been carried on.

Lignite.

In the white, quartz sands and sandstones, exposed in cliffs, on the south shore of Wapawekka lake, a bed of lignite occurs, varying in thickness from 4′–1″ (with a sandy 6 inch parting in the middle) to 2′–5″ of fairly clean lignite. The seam lies about horizontal, and was traced in a longitudinal direction for a distance of 3¼ miles, following the windings of the shore, thinning out westerly, or being represented by very dirty lignite or highly carbonaceous beds of sand; and not traceable farther easterly, owing to the higher encroachment of talus on the scarped face of the cliffs.

A proximate analysis, by fast coking, of a sample of this lignite, made by F. G. Wait of the Mines Branch, Department of Mines, gave the following results:—

Moisture	11·23
Volatile combustible matter	30·97
Fixed carbon	34·80
Ash	23·00
	100·00

Coke, non-coherent—57·80.
Fuel ratio—1 : 1·13.
Colour of ash, light orange.
Split volatile ratio—1·88.

From this analysis it will be noted that, were it not for the rather high ash percentage—which is, probably, owing partly to included sand—this might be classed as a fairly lignite coal.

The seam is at its best at the extreme southwesterly point of the bay, where it attains both its greatest thickness and greatest purity. Northeastward and northwestward along the shore, it deteriorates both in size and purity; hence, there is a reasonable probability that in the country farther south, back from the lake, where it is not exposed, the seam may be better.

An analysis by Mr. Wait of a sample received in 1907, and described as 'from an unsurveyed area lying northwest of Cumberland lake, Saskatchewan,' is, from the marked agreement between the two, probably either from the same bed or from one occurring in the same strata elsewhere. It gave the following results:—

Moisture	13·25
Volatile combustible matter	28·97
Fixed carbon	34·80
Ash	23·00
	100·00

Coke, non-coherent—57·78.
Fuel ratio—1 : 1·19.
Split volatile ratio—1·76.

Glass Sand.

The white quartz sand and loosely coherent sandstone, occurring as thick beds in the Dakota formation, on the south shore of Wapawekka lake, seem to be well adapted for the manufacture of glass. The quartz grains are subangular and are fairly uniform in size, about 93 per cent passing through a 60 mesh sieve. An unwashed sample of the sand, collected from the face of a scarped bank, was analysed by H. A. Læverin of the Mines Branch. It gave the following result:—

SiO_2 (Silica)	98·60
Fe_2O_3 (Iron oxide) Al_2O_3 (Alumina)	1·20
Other impurities	0·20
	100·00

As neither the iron oxide nor the alumina occur in the grains of quartz, but rather as coating and cementing materials, this sand after washing should be very pure indeed. The sands occur in cliffs 30 to 40 feet high, facing the lake, and are so loosely coherent as to be easily reduced and collected by the hydraulic method. Certain bands in the crystalline limestone of Lac LaRonge seem to be well adapted to furnish the lime and limestone that would be necessary in glass making. Though now inaccessible by reason of distance, these sands are commercially interesting from their close association with the lignite already referred to, and from the probability of their occurrence elsewhere in the west, in close proximity to a supply of natural gas.

Lime.

Crystalline, magnesian limestone occurs in a belt several chains wide, extending from Lac LaRonge through to the Churchill river. Thick bands of this limestone are quite suitable for burning for lime. Cliffs of the limestone border the left bank of Rapid river just above its inflow into Iskwatikan lake, the trend of the band being northeasterly (N 53° E), toward the Churchill river, which it strikes near the mouth of Rapid river; and southwesterly toward Lac LaRonge, where it forms low cliffs on some of the islands. From their highly magnesian character these limestones might also prove of value in the operation of manufacturing wood pulp by the chemical process, in the event of such an industry being inaugurated.

SIMCOE DISTRICT, ONTARIO.

(W. A. Johnston.)

INTRODUCTION.

General Statement.

The field work of the past season consisted of the topographical and geological mapping of a portion of the Lake Simcoe district, Ontario. This part of Ontario includes an area for which good topographical maps are almost entirely wanting, and in which little geological work has been done since the early exploratory work of the Geological Survey over fifty years ago. The geology of the district, although for the most part of a non-economic nature, on account of the absence, generally, of minerals of economic importance, presents several interesting problems: among them being the determination of the age of the limestones, shales, etc., which form the basal portion of the Palæozoic column, and rest upon the old Pre-Cambrian rocks, and the tracing and correlation of the abandoned shore-lines of the ancient great lakes. On account of the difficulty of carrying on geological and topographical work at the same time, the geological work has suffered somewhat, and is not complete. The present report serves merely to draw attention to some points in connexion with the general geology of the district, which seem to be of especial interest.

The topographical work was carried on by means of plane-table traverses, elevations being determined by instrumental levels and by aneroid. The plane-table sheets were completed in the field; and control for the sheets was supplied by transit and chain traverses run by Mr. Owen O'Sullivan of this Survey.

Field work lasted from June 4 until October 24, in which work the following assisted: Jas. Hill, M.A., B.Sc.; Bert. R. MacKay, B.Sc.; L. B. Adams; R. H. Blackwell, and R. A. Rogers.

Location and Area.

During the past season the topographical work on three '15'' sheets—to be known as the Barrie, Orillia, and Mud Lake sheets—was completed, and these sheets will be published on a scale of 1 mile to the inch, or $\frac{1}{62500}$. The three sheets are bounded, respectively, by latitudes 44° 15′, and 44° 30′, and longitudes 79° 30′, and 79° 45′; latitudes 44° 30′, and 44° 45′, and longitudes 79° 15′, and 79° 30′; and latitudes 44° 30′, and 44° 45′, and longitudes 79° 00′, and 79° 15′.

Previous Work.

The previous work of the Geological Survey in the Simcoe district of Ontario was done by Mr. Alexander Murray in 1852 and 1853, the results of which are given in Geology of Canada, 1863. Since that time numerous papers, by various writers, have been published: dealing chiefly with the glacial and post-glacial history of the district. Some time was spent last year by Messrs. Taylor and Goldthwait, and the writer, in an investigation of the Pleistocene geology of the district, and a short account of their work was given in the Summary Report for 1908.

Summary and Conclusion.

The examination of the solid rocks of the district has shown that the following formations are represented: Trenton, Black River, Lowville (Birdseye), and Laurentian granites and gneisses.

The age of the limestones, which have been referred to the Lowville formation, has long been in question. These limestones are regarded as belonging to the Lowville formation, from the evidence of the fossils collected from the vicinity of Lake St. John, Ont., which were determined by Mr. E. O. Ulrich of the United States Geological Survey to be all Lowville species. This formation is widespread and well represented in northwestern New York and Pennsylvania, and as far south as Kentucky and Tennessee; and the wide acquaintance of Mr. Ulrich with the palæontology of the Ordovician formations of the United States makes his determination authoritative.

At the base of the Lowville limestone there are generally from 10 to 20 feet of shales, sandstone, and arkose, which are regarded as probably forming the basal arenaceous member of the Lowville formation. They appear to be perfectly conformable with the overlying limestone; also, just such deposits would be expected whatever formation first overlaps the old land. However, on account of the absence of fossil evidence the age of these deposits is uncertain.

In connexion with the Pleistocene geology of the district, it may be stated that, no definite raised beaches or abandoned shore-lines could be found above the Algonquin beach, at least up to an elevation of 250 feet above the latter.

General Character of the District.

Over much of the district there is a heavy mantle of drift which is often of considerable thickness. Within the limits of the Barrie 15′ sheet no solid rocks are known to be exposed, and over the greater part of the sheet the drift is at least 200 feet thick; while in the northwest corner, where morainic hills rise to an elevation of over 400 feet above Lake Simcoe, it is probably much thicker. Within the Orillia and Mud Lake sheets, the drift is much thinner, and the Trenton, Black River, and Lowville limestones are often well exposed. The limestones generally form a low escarpment near the contact with the Pre-Cambrian rocks, which occupy small areas in the northern part of the sheets. Several outliers of Black River and Lowville limestone, surrounded by Pre-Cambrian rocks, occur in front of the escarpment, and sometimes at a considerable distance from it.

GENERAL GEOLOGY.

The geological formations represented in the district may be summarized as follows:—

Recent—

Humus, sand dunes, marls, etc.

Pleistocene—

(1) Raised beaches, fluviatile and lacustrine sands, gravels, and clays.
(2) Glacial clays, boulder clays, and sands; fluvio-glacial sands and gravels.
(3) Sands, silts, gravels, and clay generally stratified.
(4) Till, or boulder clay.

Ordovician—

Trenton.
Black River.
Lowville (Birdseye), including an unfossiliferous basal member of shales, sandstone, and arkose?

Pre-Cambrian—

Laurentian granites and granite gneisses.

Description of Formations.

The Lowville (Birdseye) Formation.—The most important point to be determined in connexion with the geology of the solid rocks of the district is the age of the basal members of the Palæozoic series of limestones, shales, etc., which rest unconformably upon the Pre-Cambrian rocks. The series includes upwards of 100 feet of limestones, shales, sandstone, and arkose, lying immediately below the Black River limestone. The difficulty in determining the age of these beds has been mainly owing to the fact that, they could not be definitely correlated with any of the known formations of the Ottawa or Champlain basins. The Trenton and Black River limestones are well represented in the Ottawa and Champlain basins, and continue westward into western Ontario and northwestern New York. In the Ottawa valley, at the base of the Black River limestone, there are a few feet of dove-coloured limestone which was formerly referred to the Birdseye, but lately has been generally included in the Black River. The dove-coloured limestone contains comparatively few fossils, and passes downward into the Chazy limestone characterized by a definite set of fossils. A similar succession of formations is found in the Champlain valley. As pointed out in the Summary Report for last year, it seemed possible that, in the portion of Ontario lying west of the Frontenac axis of Pre-Cambrian rocks, different conditions of sedimentation existed immediately preceding the deposition of the Black River limestone, and that the limestones, shales, etc., lying below the Black River limestone in that part of Ontario, could be more readily correlated with some one or more of the formations of the western basin. This correlation has been rendered possible by the work of Messrs. Cushing, Ulrich, and Ruedemann, in northwestern New York. In this district the first formation below the Black River is the Lowville (Birdseye): regarding which Mr. Cushing says:—[1]

'The Lowville limestone, while typically developed on the south and west side of the region, is but thinly developed in the Champlain valley, and is not sharply delimited from the formation above or below, as in the Mohawk and Black River valleys.'

Last year a small collection of fossils was obtained from the lowest fossiliferous limestones of the vicinity of Lake St. John, Ontario, and sent to Mr. E. O. Ulrich of the United States Geological Survey. The fossils were collected partly from the beds immediately underlying the Black River limestone and partly from fossiliferous beds, 30 to 40 feet lower down, and they are all, according to Mr. Ulrich, fossils of the Lowville formation. It may be stated here that the fossil described in the Summary Report for 1908, as *Tetradium fibratum*, and as occurring at the base of the Black River limestone in the Lake St. John section, was identified by Mr. Ulrich as *Tetradium cellulosum*—a characteristic fossil of the Lowville formation. *Tetradium fibratum* occurs higher up, in the beds referred to the Black River.

It would, therefore, appear certain that, these limestones should be referred to the Lowville (Birdseye) formation, and that they represent a formation which was well developed in the western basin but thinly developed in the Ottawa and Cham-

[1] Bulletin of the Geological Society of America, Vol. XIX, p. 172.

plain basins. In northwestern New York, the Lowville passes downward into a formation which Mr. Cushing has provisionally named the Pamelia, and which he regards as equivalent to the Chazy but deposited in an entirely separate basin. This formation, according to Mr. Cushing, also occurs in the vicinity of Kingston, Ontario; but no evidence has as yet been found of its extension westward into the Simcoe district of Ontario.

The Lowville limestones of the Simcoe district become arenaceous and impure toward the base, and pass downward, without apparent break, into red and green calcareous and arenaceous shales, with interstratified beds or lenses of coarse sandstone, and occasional beds of comparatively pure limestone. At the contact with the Pre-Cambrian rocks there are generally a few feet of coarse, calcareous grit or arkose containing many angular and sub-angular fragments of the immediately underlying crystalline rocks. The whole series has a maximum thickness of about 25 feet in the sections exposed in the Simcoe district. There is little definite evidence on account of the absence of fossils as to the age of this series of shales, sandstone, etc., but it is regarded as probably, the basal arenaceous member of the Lowville formation, for the following reasons:—

Just such sediments would be expected at the base of whatever formation first overlaps the old Pre-Cambrian land.

The series is apparently conformable with the overlying Lowville limestone, and occasional beds of comparatively pure limestone, apparently similar to the Lowville limestone, are interstratified with the arenaceous beds.

The arenaceous beds are local in character and distribution, and are frequently absent on ridges and knobs of the crystalline rocks, where the Lowville or Black River limestones rest directly on the old surface.

Pleistocene.

Algonquin Beach.—During the past season, the Algonquin beach was traced northward from Kirkfield, Ont., to Uphill, and instrumentally levelled at a number of localities. The beach is well developed, and can be readily traced as far as the outlier of Lowville limestone at Uphill. On lot 11, concession IX, of Carden township, the elevation of the beach is 894 feet above sea-level; one mile east of Carden post-office, its elevation is 907 feet, and one-half mile north of Uphill post-office, 923 feet. This gives a tilt rate of very nearly 4 feet per mile, from Kirkfield to Uphill, in the direction of maximum uplift. Northward from Uphill the country is low for several miles, but northeastward, in Digby township, granite hills rise above the supposed level of the beach. It would be difficult, however, and no effort has been made, to trace the beach in that direction, as there is little drift covering, and the waves of Lake Algonquin left little impression on the bare rocks.

Reported Higher Beaches.—The occurrence of raised beaches or abandoned shorelines higher than the Algonquin, in the Lake Simcoe district, has been reported from time to time.

A favourable locality for the examination of the higher levels, up to 250 feet above the Algonquin beach, is the district lying south of Allandale, Ont.; where there is a heavy mantle of drift which has suffered comparatively little erosion. In the vicinity of Holly and Thornton, the drift forms a plateau-like upland, the general level of which is about 300 feet above Lake Simcoe.

In carrying on the topographical work in this area, instrumental levels were obtained over most of the roads, and an opportunity was afforded of determining the elevation of all land forms which bore a resemblance to beach markings or deposits. Numerous broad, flattened, kame-like deposits of stratified sand and gravel occur at various levels above the Algonquin beach up to an elevation of 1,025 feet above sea-

level; but these deposits are generally lacking in any definite horizontality or accordance of levels, and no cuttings were seen from which such deposits could have been derived by wave action or shore currents. Hence, such deposits are regarded rather as a product of fluvio-glacial action. It is possible that faint beach markings of local glacial lakes may occur, but none were seen that could be traced for any distance.

ECONOMIC GEOLOGY.

The Black River limestones of the district are used most extensively for the manufacture of lime, and the Lowville limestones furnish the best building stone. The latter are extensively worked at the Longford quarries, on the west side of Lake St. John, in Rama township; and similar beds of limestone with little over-burden, outcrop in the vicinity of Sebright, Ont., and for several miles westward, where they could be easily worked.

APPENDIX.

Since going to press, a report has been received from Mr. E. O. Ulrich, of the United States Geological Survey, on a collection of fossils obtained by the writer from the supposed Black River and Lowville limestones of the vicinity of Lake Couchiching, Ontario. Mr. Ulrich concludes, from an examination of the fossils, that the true Black River limestone as defined by the early New York State geologists is not present, or at least not recognizable in south-central Ontario, and that the cherty beds which have been included in the Black River formation should rather be given a distinct name derived from some locality in the district, considering: (1) 'that the stratigraphic and faunal break between the cherty zone and the 7 ft. tier (the true Black River) deserves recognition in stratigraphic classification; (2) that the Lowville formation as now fixed should not include the cherty bed.'

To meet this objection of including the cherty beds in the Black River formation, Messrs. Cushing and Ruedemann, in a communication to the Director of this Survey, propose to refer all the beds between the base of the Trenton and the Pamelia of Stones River (Chazy) age to the Black River group, including the cherty beds in the Lowville formation, under a distinct local name. This question in its relationship to the formations of south-central Ontario will be taken up more fully in the final report on the district.

The following is a list of the fossils:—

(1) *Lower Middle Lowville.*—

The fossils were obtained from a small quarry in North Orillia township, Ontario, 3 miles west of Washago. The beds from which the fossils were collected are about 10 feet in thickness, and constitute the lowest fossiliferous limestones seen in the district, and are separated from the red and green shales, which form the base of the section, by only a few feet of impure limestone:—

Refinesquina minnesotensis.
Cyrtodonta, n. sp.? closely allied to *C. janesvillensis* and *C. huronensis.*
C. sillimanensis?
Vanuxemia rotundata.
Pterotheca attenuata.
Pterotheca, sp. undet.
Helicotoma, n. sp.
Liospira progne.
Liospira vitruvia.
Eotomaria vicinus.

Clathrospira subconica.
Lophospira concinnula, var.
Holopea, cf. *concinnula.*
Subulites, n. sp. (near *S. regularis*).
Cameroceras, sp. undet.
Orthoceras, cf. *recticamerata.*
Isotelus, cf. *obtusus.*

(2) *Upper Lowville.*—

Fossils obtained in North Orillia township, Ontario, from beds which are about 20 feet in thickness, and are about 40 feet higher up in the section:—

Tetradium cellulosum.
Ctenodonta, cf. *gibberula.*
Liospira, sp. undet.
Hormotoma angustata.
Trochonema, sp. undet.
Orthoceras, near *O. recticameratum.*
Cycloceras, sp. nov. (near *O. perroti*, Clarke).
Isochilina armata.

(3) Suggested new formation, which Cushing and Ruedemann propose to include in the Lowville under the name of the Leray limestone member.

Fossils obtained in North Orillia township, Ontario, from the cherty beds, which are about 20 feet in thickness, and immediately overlie the beds of the upper Lowville:—

Girvanella, sp.
Columnaria halli.
Tetradium fibratum.
Streptelasma profundum?
Beatricea gracilis.
Escharopora subrecta?
Nicholsonella, cf. *laminata* and *cumulata.*
Strophomena filitexta, var.
Refinesquina minnesotensis?
Orthis tricenaria.
Camerella panderi, var. nov.
Ctenodonta, cf, *logani.*
Ctenodonta, cf. *scofieldi.*
Helicotoma planulata.
Lophospira, sp. undet.
Hormotoma salteri canadensis.
Orthoceras, small, pencil size.
Orthoceras, large species, externally resembling *Ormoceras tenuifilum.*
Actinoceras, sp, undet.
Cycloceras, sp. undet.
Cycloceras? arenoliratum.

FIELD STUDIES ON THE PLEISTOCENE DEPOSITS OF SOUTHWESTERN ONTARIO.

(F. B. Taylor.)

Work was begun at St. Marys, Perth county, Ontario, on October 7, and closed at Tillsonburg, Oxford county, Ontario, on November 6. The plan of spending two, or two and one-half months on this work was unavoidably shortened to one month. The first three weeks were spent in studying the glacial features and deposits of the central part of the peninsula, in an area running north and northeast from Lucan and St. Marys to Mount Forest and Orangeville. The remaining time was given to studies near Dunnville, Caledonia, Hagersville, Simcoe, and Tillsonburg, collecting further details where earlier independent studies had been made.

The Glacial Features of the Central Plain.

Terminal Moraines of the Lake Huron Ice Lobe.—In studies made before 1908, four terminal moraines were mapped for short distances across the western and northwestern part of the township of London, in Middlesex county. These moraines are slender and lightly formed, but are clearly defined as topographic features, and are easily traced. They are simple ridges of stony clay with only one crest, and are generally a mile or less in width. The height of the crest above the adjacent plain varies from 15 or 20 feet, to 70 or 80 feet; though seldom rising above 40 or 50 feet.

In western London township, these ridges run nearly north and south. One passes through Ettrick, to the Thames river 2 miles east of Melrose; another runs through Lobo and Telfer, half a mile east of Ilderton; another runs close west of Vanneck, one mile east of Denfield, and through Lucan; and another runs through Duncrief, just west of Denfield and one mile west of Lucan crossing. From these fragments previously mapped, the studies of the present season were carried north and northeast.

All four of these terminal moraines belong to the Lake Huron lobe of the ice sheet: i.e., they were made at the ice margin by ice moving toward the east and southeast from the central axis of the Lake Huron basin. The most easterly ridge of the four was, therefore, made first, the first one west of this was the next in order of formation, and so on. These four moraines, with the intervening till plains, glacial border drainage lines, and glacio-fluvial deposits were studied, in considerable detail, up to Seaforth, Mitchell, and Stratford.

In the vicinity of Denfield the four moraines are set close together, the distance across the series from east to west being not over 5 miles. This is because they lie upon land that slopes rapidly down to the west, so that the ice was advancing up the slope during the oscillations of its retreating phase. Going north, the moraines rise gradually to the flat, central plain, and spread between Walton and Milverton to over four times the space at Denfield. The moraines themselves are no wider or larger, but they are spaced with wider stretches of till plain between them. In view of their sharply-defined and continuous character as ridges running for many miles across the country, I have, as a matter of temporary convenience, adopted names for these four moraines. The first, which is the one that passes through Ettrick at the south, also passes through Milverton, and is called the Milverton moraine; the second passes just west of Mitchell, and is called the Mitchell moraine; the third passes through Lucan, and is called the Lucan moraine, and the fourth passes through Seaforth, and is called the Seaforth moraine.

The Interlobate Area.—The work from St. Marys and Stratford shows that the country for at least 15 to 20 miles east of the Milverton moraine is an interlobate plain, with no simple terminal moraines in it; but with several pronounced but rather small interlobate morainic areas. One of these—the only one which was examined—lies north of Shakespeare, in North Easthope. This is a characteristic interlobate deposit, higher than an ordinary terminal moraine, and with prominent knob and basin development. Many kames and other glacio-fluvial deposits are associated with it. Beginning one mile east of Brocksden, this deposit extends toward the northeast, with a width of 2 or 3 miles, and appears to extend into the northwest part of Wilmot township, though it was not followed beyond 2 miles east of Amulree.

The Milverton Moraine.—The desirability of completing the definition of the western border of the interlobate area, and the shortness of time remaining for field work, led me to drop for the time the detailed work on the three later moraines, and push the study of the Milverton moraine.

From a point about 2 miles west of Hyde Park, where this moraine meets the Thames river, it takes a fairly direct course toward the north-northeast, and was traced continuously to a point near Conn, about 10 miles east of Mount Forest, a total distance of about 80 miles on a straight line. In the last 10 or 15 miles the moraine loses much of its strength, and was quite difficult to follow beyond Riverstown. Although its course is in a fairly direct line, its deviations show three distinct but faintly developed lobes projecting eastward, with rather sharp re-entrant angles between. So far as they were followed the Mitchell, Lucan, and Seaforth moraines appear to show less tendency to the development of lobes.

Till Plains.—Throughout much of this area the till plains which lie between the moraines and east of the Milverton moraine are excellent examples of their class. To the eye they appear as flat as the ocean in a time of calm. Such are the stretches north of Stratford and east, west, and southwest of Milverton. It might be thought that these areas are floored with lake clays, but the evidence seen was against this view. The clays did not appear to be laminated, though sometimes showing obscure bedding planes, like those occasionally found in true till. In some places stones and pebbles were very scarce, but they appeared to be always present in small quantities. These characters are clearly distinguished from those of true lake clays such as cover the country in some other parts of the peninsula: notably, those at Schomberg, and between Caledonia and Hagersville.

Moraines on the East Side of the Interlobate Area.—Some strongly developed morainic deposits were found between Arthur and Alma, but their character and relations were not fully made out. Just east of Orangeville junction, crossing the railway from the north and turning west so as to pass 2 or 3 miles south of Waldemar, a very strong terminal moraine was found which belongs to the Lake Ontario lobe of the ice sheet. This moraine was, therefore, made at the margin of ice moving up the slope from the east and southeast. It seems quite certain that this moraine forms a part of the eastern boundary of the interlobate area, and probably includes the morainic fragment near Alma. Studies made several years ago disclosed a great terminal moraine running north from Ayr and swinging in a broad curve to the west so as to pass close west of Berlin and Waterloo; thence it runs west to Bamberg, where it turns to the north. This Waterloo moraine, as it is called, belongs to the Lake Ontario lobe, and appears to be another fragment of the eastern boundary of the interlobate area. In the northern part of the city of London a low morainic ridge trends east and west, and may be another fragment of the same. Excepting these fragments, the eastern boundary of the interlobate area has not yet been worked out. The moraines east of the Waterloo, however, were mapped in considerable detail in 1899.

It seems probable that the interlobate area extends to a point 5 or 10 miles northeast of Dundalk, thus having a total length of about 100 miles. The Milverton moraine, so far as it has been traced, sharply defined its western boundary, and it seems probable, though it is not yet certain, that the Milverton and Waterloo moraines were made at the same time.

Ice Border Drainage Systems.—The drainage systems developed in the interlobate area and along the front of the ice at the successive halts on the above-mentioned moraines, are well developed, but rather complicated. In some places they are quite striking, as at St. Marys, where gravel terraces distinctly above the modern flood plain record the former greater stream. There were many shiftings of drainage lines as the ice front retreated. For instance, when the ice rested on the Milverton moraine, a stream of considerable volume came from the northeast past Amulree and Brocksden and down the Avon. From St. Marys it followed the Thames to London. But at the next halt of the ice (on the Mitchell moraine) this stream abandoned the Thames at a point about 5 miles west of St. Marys, passed through to the rear side of the Milverton moraine, north of Prospect Hill, south of Granton, just north of Elginfield and west of Southgate, and on down Oxbow creek. This is a splendid specimen of an abandoned river bed occupied only temporarily. South of Granton it is a flat, swampy floor about one-third of a mile wide, and is not now occupied by any stream.

Glacio-fluvial Deposits.—Asociated with the moraines, many kames and kame-like gravel deposits were found, due evidently to waters issuing from dirty ice. In several places eskers or serpentine kames were found, well developed. South of Blyth there is a remarkable area of eskers running up the slope eastward and ending mostly in kame clusters of very pronounced development. The most remarkable individual esker observed extends for about 10 miles toward the southeast from a point 2 miles east of Mount Forest. The end of this ridge was not determined in either direction, and it may be much longer. It seems to record a time when the ice was very thin over the central area of the peninsula. Many other shorter fragments were found.

Some Events of Glacial History in the Central Part of the Peninsula.—The history revealed by these formations is an interesting one from the point of view of the influence of land relief upon ice movements. At its maximum extent the ice sheet no doubt covered this entire region to a depth of several hundred feet, but even then the lines of strongest ice flow were determined by the position and trend of the relatively deep basins of the Great Lakes, and the flow was less rapid over areas of high land. This effect upon the ice flow caused the surface of the ice, even at its greatest extent, to be higher along the axes of the lake basins than over the intervening areas of high land, and there was, in consequence, a depression in the surface of the ice over the latter. This was true even before any part of the land of this peninsula was uncovered. Thus, with the continued recession of the ice sheet the covering of ice over the high ground became progressively thinner, until it finally parted and drew back on both sides, leaving bare the interlobate area which these studies have disclosed. At the first halt of the ice front after the uncovering of the interlobate area, the front rested on the Milverton moraine on the west side and probably on the Waterloo moraine on the east. At a point 5 or 6 miles west of London, the Milverton moraine coming from the north unites with the London (Waterloo?) moraine coming from the east, indicating coalescence of the ice of the Huron and Erie ice lobes, one moving toward the southeast from Lake Huron, the other toward the northwest from Lake Erie. From this point the two ice lobes were undoubtedly united at this stage of retreat for at least 100 miles or more toward the southwest. Thus, at its first appearance the interlobate area terminated at the south-

west, where the two moraines now meet west of London. But, although the two ice lobes coalesced, the surface of the ice must still have remained lower along the line of contact than along the axes of the two lake basins. Hence, there was in all probability a wide, shallow depression or crease along the line of contact. In times of melting, this crease must have carried a great amount of water derived from melting over a vast extent of the ice sheet, and this occurred both before and after the uncovering of the interlobate area described above. It is interesting to note that there are features in eastern Indiana and northwestern Ohio which are almost certainly referable to the great glacial Crease river which came from the interlobate depression in Ontario, and that these features do not appear to be otherwise explainable.

Notes on Glacial and Lake Features Between Dunnville and Tillsonburg.

The region between Dunnville, Caledonia, and Simcoe is one in which terminal moraines have not yet been found with certainty. Whether this is due in reality to their absence or to extreme faintness of expression because of deposition by ice standing in deep water, has not yet been determined. Some fragments of doubtful origin that were found in this area may turn out to be waterlaid moraines, but further study in the field will be necessary to determine their character.

A new area of drumlins was found on the plain north of Hagersville. They are of the long, narrow type and are very well formed with axes running S 70° or 75° W. They rise out of an extensive bed of lake clays, laminated and without pebbles. The drumlins themselves are quite bouldery, so much so as to suggest that they may have been washed to some extent by waves.

The strong moraine which passes just east of Waterford and Simcoe was found to extend a little west of south toward Normandale. The plain reaching some miles north and east from Port Dover is remarkable for its flatness. It appears, however, to be composed of till with some stones, and with little or no lake clay upon it.

A strong terminal moraine belonging to the Lake Erie ice lobe, and hence made by ice moving toward the north, was found running east from Tillsonburg, passing just north of Cornell and a mile south of Otterville. What appears to be this same moraine runs west from Tillsonburg, passing just north of Delmer, Brownsville, and Springfield. A fragment of another strong high moraine of the Lake Erie lobe was seen at Mount Elgin, with northeast and southwest trend. A well marked line of glacial border drainage coming from the east breaks through the Tillsonburg moraine a mile north of the town. For 10 miles or more east of Tillsonburg the country south of the moraine is covered with fine sand, apparently marking a former lake border, but no well-defined beach was observed here. Near Courtland, however, farther south and at a lower level, there are some sandy beach ridges.

THE FLORENCE LAKE AND MONTREAL RIVER DISTRICTS.

(W. H. Collins.)

INTRODUCTION.

The geological exploration of the Montreal River district, begun in 1908, was continued during the past summer. The silver-bearing areas of James township and Maple mountain were explored for the Bureau of Mines in 1907 by Mr. C. W. Knight. In 1908, this work was continued by Mr. A. G. Burrows in the Miller Lake area. These, and the area covered by the writer in 1908, although almost identical in geological character, remained isolated. In order to establish a direct relationship between these separate areas, attention was directed, this year, to the unexplored intervals, especially those between Montreal river and its East branch. Meanwhile, Mr. Burrows of the Bureau of Mines, continued his detailed work in the vicinity of Gowganda, covering Van Hise, Haultain, Milner, Nicol, Leith, and Charters townships. Sufficient information has now been obtained, collectively, to map a continuous area of 900 square miles: which includes Elk Lake, Silver Lake, Miller Lake, Gowganda, and Maple Mountain mineralized areas. In addition, 40 square miles around Florence lake, which had attracted the attention of prospectors during the summer, were explored.

Work was carried on between May 28 and September 28. In connexion with the areal geology, micrometer-compass surveys were made along lakes and navigable streams. A partial system of hand-levels was also carried from the Timiskaming and Northern Ontario railway at Latchford, along Montreal and Lady Evelyn rivers. Both Montreal and Lady Evelyn rivers are sluggish streams with almost negligible gradients, or form chains of lake expansions separated by falls and rapids. By levelling over these obstructions and the watershed which separates the two streams near Smoothwater lake, and elsewhere estimating the gentle gradient, a closed circuit was obtained in which the error for any elevation is probably less than 3 feet. Aneroid determinations of hills and remote lakes are based on this series of levels.

The satisfactory progress of the work was due, in no small measure, to the assistants of the party: Messrs. H. C. Cooke, J. D. Trueman, and J. R. Marshall. Co-operation with Messrs. A. G. Burrows and W. R. Rogers, who represented the Ontario Bureau of Mines, also proved advantageous; while from mine officials and the people of the district a frank, courteous treatment was almost invariably received.

FLORENCE LAKE DISTRICT.

Access.

Florence lake—a headwater of Lady Evelyn river, lying 35 miles west of Latchford—is most easily reached from Timagami or Latchford station, on the Timiskaming and Northern Ontario railway. From Latchford, Montreal River steamboats may be taken as far as Mattawapika falls, but beyond that point Lady Evelyn river must be ascended in canoes. The whole distance is only 65 miles, but travel on the Lady Evelyn is rendered arduous by numerous and difficult portages. From Timagami lake, steamers may be utilized for about one-third the distance. Details of both routes are shown on the Timiskaming map-sheet published by the Department of the Interior, Ottawa.

General Character.

Florence lake is an irregular body of beautifully clear water, 6 miles in length, lying 1,190 feet above sea-level. Its shores are for the most part bold and rocky, and for 3 miles inland in any direction—except to the north, where the ground is swampy—the country rises in bare, rounded hills to heights of from 200 feet to 550 feet above the lake. As a rule, soil is scanty, but near the outlet the rocks are covered by a heavy mantle of glacial sand. Timber is abundant and of good size. Lake trout are plentiful.

General Geology.

The geology of the district is simple: a quartzite of Huronian age, traversed by sills and dikes of diabase, covers most of the area. The quartzite is a greyish or greenish-white rock, usually feldspathic, which frequently grades into arkose, or becomes finely conglomeratic. The bedding planes are indistinct, so that the rock has a massive appearance, and the dip and strike are seldom determinable. A few reliable observations of the dip indicate a gently undulating attitude, with a general southeasterly inclination. The diabase is quite similar to that found in the Montreal River district. It forms two sills and a number of dikes, of which only the sills are of economic interest. The smaller of these lies immediately southeast of Florence lake, the larger extends across it and, at the north end, spreads out irregularly. The diabase exhibits the usual fine-grained and gabbroid types, and ocasionally an acid, syenitic phase. It is cut by small aplite dikes and quartz-calcite veins. Movements, unimportant in extent, are indicated by the vein-filled fissures, and by local shear zones a few inches wide in the quartzite where the rock has been rendered schistose, with development of sericitic material.

Economic Geology.

The quartz-calcite veins show the same structure as those in the Montreal River district, but were observed to carry only chalcopyrite, except at one point near the middle of Florence lake, where a trace of cobalt bloom was perceived. Many prospectors visited the district during the summer, though up to the middle of June apparently without success. Two of these, however, Messrs. Roy and English, state that native silver was discovered in August near the smaller diabase sill.

MONTREAL RIVER DISTRICT.

General Character.

As the work in the Montreal River district was an extension of that performed last year, it is only necessary to amplify the general topographical and geological accounts given in recent reports.[1] The area now explored, though presenting at all points the uneven, rocky surface characteristic of the Pre-Cambrian region, exhibits certain local differences, especially notable in the decreasing dip of the Huronian beds as one proceeds from west to east. In consequence of this, the parallel north-south, Huronian ridges, with steep western and gentle eastern slopes, which are such a constant feature in the vicinity of the West branch, become less conspicuous farther east, where the ridges run in various directions, and are partly replaced by hills of irregular outlines. The townships of Farr, James, and Mickle, and most of the country to the south, are especially irregular. The central and eastern portions, which are heavily drift-covered in places, are not very rugged, the hills being mostly under

[1] Burrows, A. G., The Gowganda and Miller Lake Silver Areas. 18th Ann. Rep. Bureau of Mines, Pt. II.
Collins, W. H., Preliminary Report on Gowganda Mining Division. Geological Survey, 1909.

200 feet in height; but north and west of Duncan lake, and between Macobe and Lady Evelyn lakes on the southeast, the relief is greater. Maple mountain, in the latter locality, is approximately 2,000 feet above sea-level.

The above-mentioned topographical irregularity in the neighbourhood of Elk lake has evidently influenced Bear river and its branches, which ramify in various directions instead of pursuing parallel, zigzag courses like the East and West branches. All the branches are navigable in small canoes; but meandering courses and numerous shallow rapids greatly lessen their values as waterways. The North branch of the river flows through a soil-covered area, and is consequently almost devoid of the rocky lake expansions so common on the South branch, or the Sydney Creek system farther west.

Access.

As roads continue to be opened through the country, canoe traffic is being gradualy superseded. A graded wagon road, 27 miles long, has been constructed by the Ontario government, between Gowganda and Elk Lake, with branches to Silver Lake, and Miller Lake mining camps, thus establishing communication with the Timiskaming and Northern Ontario railway at Charlton during winter, and with Latchford in summer. The Canadian Northern Railway extension from Sudbury is being continued, and before the end of the year will reach Oshawong lake (Gowganda Junction), about 45 miles southwest of Gowganda. A road now in preparation between these points will replace the Sellwood route used last winter. Short wagon roads have been constructed from Mountain lake to various mining camps in Willet township; from Lady Evelyn lake to the Maple Mountain camps; and elsewhere.

General Geology.

For convenience, the general geological structure of the district is restated. An uneven, erosion floor of highly metamorphosed, crystalline rocks (Keewatin and Laurentian) is overlain by a series of comparatively unaltered, gently tilted sediments (Huronian). Both are penetrated by dikes and sills of diabase, and the whole so deeply denuded as to re-expose portions of the old crystalline basement. Glacial drift is spread unevenly over the solid rock surface.

In the area explored this summer, between Sydney creek and Montreal river, the Keewatin-Laurentian basement is entirely hidden by the Huronian, except to the north of the Stony Creek canoe route, whence granite and gneiss extend northward and westward. As these rocks are neither of special economic interest nor largely exposed, they need be given no further mention.

The Huronian is the most widely spread series. Structurally and in composition, it presents considerable contrast to that seen farther west in the vicinity of Duncan lake in 1908; a fairly steady variation in these respects being observable along a northwest-southeast line through the district. In the northwest, about Duncan lake, the series consists of conglomerate, greywacke, slate, and some quartzite, often complexly alternating, and always inclined to the east, at angles of from 15° to 45°. Toward the middle of the district, in Haultain and Lawson townships, the dip decreases to from 5° to 15°, and quartzite, with its arkose and conglomeratic varieties, becomes relatively abundant. Finally, the whole southern part as far as Lady Evelyn river is wholly underlain by these varieties, lying in low folds with dips of only a few degrees. It is possible that the quartzite stands high in the series, and that its wide distribution in the south is due to the greater thickness of the Huronian in that region; but at Gowganda, Duncan lake, and elsewhere, quartzite occurs near the base of the series, and appears, in part at least, to displace rather than overlie the slate and greywacke.

The continued examination of the diabase masses proves them to be either dikes or sills. The former, which are very numerous, appear to have been the vents through

which the sill-forming material arose. Though in many cases attaining widths of a hundred feet, they are of no economic interest. The sills are associated with the Huronian series, beneath or within which they have been intruded, and their attitudes appear to be controlled by the Huronian beds. In the west, where the Huronian is most inclined, the sills are also inclined, and outcrop only edgewise in narrow bands; while in the vicinity of Elk lake, where the Huronian is approximately flat-lying, erosion has exposed large, equidimensional patches of the equally flat-lying diabase. The Miller Lake and Gowganda sills are intermediate in this respect, exhibiting a general north-south elongation.

In addition to the region already mapped, considerable areas of diabase were found in Willet, Shillington, Trethewey, and Gamble townships. Olivine-diabase dikes similar to those observed last year were found at wide intervals over the entire district. They are distinguished from the commoner quartz-diabase dikes by conspicuous feldspar crystals, ranging up to 4 inches in diameter.

Over most of the district the covering of glacial sands and gravels is thin and sporadic. However, an extensive area, including most of Chown, and portions of Lawson, Mickle, and James townships is buried, in places to depths of a hundred feet. A smaller sandy area extends up the Montreal river from the one-and-a-half mile portage.

Economic Geology.

Explorations in the Montreal River district sustain to a remarkable degree the idea of an intimate relationship between the quartz-diabase and the silver-cobalt vein deposits suggested by W. G. Miller, the provincial geologist, who studied the conditions existing at Cobalt. Throughout a mineralized region 80 miles in length these veins occur always within or in close proximity to the diabase. It is believed that the ores of silver, cobalt, and nickel which they carry were eliminated from the diabase magma in the form of a highly aqueous solution. The quartz which forms part of the gangue probably originated in the same manner, but there is reason to believe that the calcite, which is commonly a more abundant gangue mineral, was dissolved from other rocks—probably the Keewatin—to which the vein-filling solutions had access.

The known areal distribution of the silver-cobalt minerals has been extended during 1909. Silver was found about the end of June in the southeastern portion of Leith township, near Flanagan lake. According to Mr. Burrows, the geological features in this locality are identical with those of Gowganda; Huronian slate, greywacke, conglomerate, and quartzite being intruded by a sill and numerous dikes of diabase. Narrow calcite veins carry native silver, smaltite, niccolite, and native bismuth: good showings of which were seen on H.S. 693 and H.S. 716. Silver has also been found in Lawson township, along the north border of Willet township, and on the west side of the East branch a short distance south of Charters township. In addition, seemingly truthful reports of the occurrence of silver have been received from Shining-tree Lake district, and from Rosie creek, 15 miles farther south along the Algoma-Nipissing boundary line.

Discoveries, such as the Morrison vein 2 miles south of Miller lake, continue to be made in the Gowganda and Miller Lake areas as further surface exploration is prosecuted. When it is considered that certain Huronian areas, such as that lying northeast of Elkhorn lake, are probably underlain at no great depths by the intrusive sills, it would seem that attention has been too closely confined to the diabase. That mineralized veins do occur outside but near the diabase, is instanced by the Blackburn property near Miller lake, and the North American at Silver lake; in the latter case a silver-carrying vein passes from the diabase upward into quartzite.

Mining camps now exist at Elk lake, Silver lake, Miller lake, Gowganda, and Maple mountain, at each of which about the same amount of progress has been made

under nearly identical physical conditions. The Elk Lake and Silver Lake camps are somewhat older than the others, and have enjoyed better transportation facilities, but at present all of them are reasonably well connected. The more active mines in each camp are similarly equipped with boilers, air compressors of capacities up to 900 cubic feet, hoists, and air drills, besides suitable buildings for housing from 10 to 70 men. The amount of work performed with these plants since their installation varies greatly; in a few of the most progressive mines the underground work aggregates 800 feet in length, their shafts reaching depths of from 100 to 160 feet. Surface exploration is being actively continued. At Gowganda, progress of this description is being made on the Reeve-Dobie, Bartlett, Mann, and Boyd-Gordon properties; at Miller lake, on the Gates, Blackburn, and Bonsall, where, however, operations have been suspended; at Silver lake, on the Otisse, Otisse-Currie, and North American; at Elk lake, on the Elk Lake Discovery, Silver Alliance, Toledo, Gavin Hamilton, Moosehorn, Elk Lake, Cobalt, Big Six, and others; and at Maple mountain, on the White Reserve, and Maple Mountain properties. The Silver Lake Mining Company, at Silver lake, is exploring with a diamond drill. There are also other properties, too numerous to mention individually, where both underground and surface exploration is being performed without machinery.

As far as can be learned, a few tons, in one case seven, have been shipped by some of the working mines; but a majority of those above named have two carloads or less of rich ore, and larger quantities of low grade ready for shipment. Valuable ore was seen in place in the Maple Mountain, Gowganda, and Miller Lake districts, but estimates of the amounts available are only conjectural.

Underground exploration performed thus far in the Gowganda and Miller Lake districts indicates that the rich ore—the discovery of which at the surface created such high expectations—is irregularly distributed. A number of veins, the surface values of which were remarkably high, have become barren at moderate depths. This erratic occurrence of ore is being recognized, and hope is entertained of the existence of veins in which the mineralized portions lie wholly below the surface. Search for these is often facilitated by a parallel arrangement of the veins, so that trenching or cross-cutting at right angles to one will expose the others. Less is known about the Silver Lake and Elk Lake properties, but those visited do not appear to yield the rich masses seen elsewhere. At Maple mountain, some of the veins discovered on the surface have disappeared at a few feet down; but, in one case, good ore has been followed to a depth of 150 feet.

Future Possibilities.

The outlook of the district, as inferred from recent work, appears to be satisfactory, although not equal to sanguine earlier expectations. Valuable discoveries, such as that on the Morrison property, which continue to be made within the limits of the mining camps, indicate how imperfectly known even the best explored localities are. Indeed, the advantage offered by an exposed, deeply-eroded rock surface, in the search for ore has been under-rated, effort being directed to the much costlier and but little more efficacious underground work rather than to trenching on the surface. The possibilities of the surrounding country, judging from the recent discoveries at Flanagan lake, Shining-tree lake, Willet township, and elsewhere, are not by any means exhausted, nor are the limits of the silver-bearing region known.

This widespread distribution offers serious disadvantages to economical mining. The ore bodies now known are large enough to be profitably operated, but, when these are exhausted, extensive explorations through barren rock will be necessary to locate new ones which may not reach the surface. By way of compensation, expenses in the Gowganda and Miller Lake camps should be reduced by the improved roads that will be opened for traffic this winter.

LARDER LAKE AND EASTWARD.

(Morley E. Wilson.)

INTRODUCTION.

The field season of 1909 was spent by the writer in extending the geological investigations commenced in 1908 in the vicinity of Lake Opasatika, Pontiac county, Quebec, to Barrière and Kekeko lakes on the east, and across the interprovincial boundary to Larder lake, Ontario, on the west. By the completion of this work the necessary data have been procured for the publication of a geological map on the scale of 1 mile to 1 inch, of a district having an approximate area of 600 square miles: comprising the townships of McVittie, McGarry, Hearst, McFadden, Skead, and Rattray, in Ontario; and the townships of Dufay, Montbeillard, the southern parts of Dasserat and Boischatel, and the northern parts of Pontleroy and Desandrouins, in Quebec.

Although this region is intersected by a number of township lines surveyed by the Crown Lands Departments of Ontario and Quebec, very few of the numerous lakes and watercourses had been mapped with sufficient accuracy—if mapped at all—to warrant their use in a map of the proposed scale; it was, therefore, necessary to make surveys of all the hydrographic features of the region. During the past summer this part of the work was carried on by Mr. Robert Harvie, of McGill University; while the writer devoted his attention to the geological features of the district.

A number of geological reports have been published at various times on portions of the above area, but have all been of a reconnaissance or preliminary character. In 1872, Mr. Walter McOuat, in the course of an exploratory trip from Lake Timiskaming to Abitibi, made a geological examination of the shores of Lake Opasatika, an account of which appeared in the Report of the Geological Survey for 1872-3. During the summer of 1901, Dr. W. G. Miller, Provincial Geologist of Ontario, made a reconnaissance trip from Lake Timiskaming to the height of land, by way of the Blanche river and Windigo, Larder, and Beaverhouse lakes. His observations along the route were published in the Report of the Ontario Bureau of Mines for the year 1902. A geological reconnaissance of the country north of Lake Timiskaming was made for the Geological Survey by Dr. W. A. Parks, of Toronto University, in 1904. This work—an outline of which was published in the 1904 Summary Report of the Geological Survey—included the geological examination and survey of some of the principal waterways described below. In 1907, Mr. R. W. Brock made a geological report on the Larder Lake district for the Ontario Bureau of Mines. This report, however, was based on field work which occupied less than two weeks' time.

TOPOGRAPHY.

The Larder Lake district, and the adjoining portions of Pontiac county, present the typical physical features which characterize the Pre-Cambrian of northern Ontario and Quebec. To the east of Lake Opasatika, a large clay area occurs, in which rock exposures are rarely observed. This comprises nearly the whole of Montbeillard township. In the southwestern part of the area mapped—Skead and Hearst townships—the rock surface is largely obscured by glacial sand and till. With the exception of the two localities just mentioned, the country is comparatively rocky, more especially so where the rugged ridges of Huronian rise to elevations of from 600 to 700 feet above the surrounding country.

Since nearly the whole of this region is on the south side of the height of land, the drainage is largely into Lake Timiskaming: in the eastern part by way of Rivière and Lac des Quinze; in the western by way of the Blanche river. There are, however, a few lakes at the northern extremity of the sheet, beyond the St. Lawrence-Hudson Bay divide, which drain into Island (Mattawagosik) lake, and thence to Lake Abitibi and James bay.

GEOLOGY.

In a general way, the rocks of this area afford a very distinct record of geological events. At the base of the whole region is a complex group largely igneous, comprising the Laurentian and Keewatin, the members of which, although of different age, are all distinguished by their greatly disturbed and metamorphosed character. Resting unconformably on the uneven surface of this ancient complex is a series of but slightly disturbed Huronian sediments—conglomerate, greywacke, and arkose. These sediments—with the exception of a few local intrusives, which are post-Huronian in age—comprise the youngest rocks in the region; any sediments that may have been deposited between that time and the deposition of the glacial drift, having since been entirely removed by erosion.

The geological succession is outlined in detail in the following table:—

Pleistocene and Recent—
Post-glacial: clay, sand, and gravel.
Glacial: boulder clay, sand, and gravel.
Unconformity.

Post-Huronian—
Diabase, gabbro, porphyry, and lamprophyre.
Igneous contact.

Huronian—
Conglomerate.
Arkose.
Greywacke.
Conglomerate.
Unconformity.

Laurentian—
Granite, gneiss, pegmatite, and aplite.
Igneous contact.

Keewatin—
Quartz-porphyry and porphyrite
Rusty weathering carbonate rock.
Phyllite, slate, and greywacke.
Greenstone, and greenschist
(Pontiac schist.)[1]

Keewatin.

The Keewatin series consists of a complex group of rocks, chiefly igneous, although containing some sediments, all of which have been greatly disturbed and more or less metamorphosed. These changes have beeen carried so far, in many cases, that it is exceedingly difficult to determine either their original character or structure.

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1 Placed provisionally in the Keewatin

Pontiac Schist.—To the east of Lake Opasatika an area of nearly 100 square miles is occupied by very uniform, fine-grained mica schists, which, in their mineralogical composition, correspond to metamorphosed quartzites and arkoses. They consist chiefly of quartz and biotite, with usually some feldspar, either orthoclase or albite. Owing to the widespread occurrence of this rock in Pontiac county, and the distinct characteristics which separate it from all the other rocks of the region, it has been given the local name, Pontiac schist.

With regard to the age of the Pontiac schist, two facts are known: it is overlain unconformably by the Huronian, and is intruded in a most complex manner over wide areas by Laurentian granite and gneiss. It forms, therefore, part of the great fundamental complex, which in this region suffered peneplanation during the long interval that elapsed prior to the deposition of the Huronian clastics. Since the nomenclature adopted by the International Committee for Lake Superior geology makes no provision for this rock, it should properly be regarded as a distinct, new series; but in the absence of more definite knowledge with regard to its age and importance, it has been placed provisionally in the Keewatin.

Greenstone and Greenschist.—By far the larger part of the Keewatin is made up of basic igneous rocks, which may be described in general as greenstones and greenschists. These include basalt, gabbro, diorite, and chlorite and hornblende schist. They generally contain a considerable quantity of pyrite and carbonate, and in many places show spheroidal and amygdaloidal structures.

Phyllite, Slate, and Greywacke.—On the north shore of Larder lake, there is a belt—nearly 1 mile wide—of interbanded phyllites, slates, and greywackes, which parallels the lake shore for several miles. These rocks have a nearly vertical attitude; a uniform northeasterly strike; are in places, graphitic; and locally contain small quantities of iron ore formation.

Rusty Weathering Carbonate Rock.—In the neighbourhood of Larder lake, and north of Lake Opasatika, are local outcrops and bands of a rusty weathering rock, consisting of ferruginous dolomite or ankerite, with varying quantities of quartz and feldspar. It is always highly pyritic, and in most localities contains a large amount of chrome mica or fuchsite, from which the rock derives its characteristic green colour. As a rule, the rock is cut in a most complex manner by two or more sets of veinlets consisting of quartz or of quartz and ferruginous dolomite, the dolomite occurring along the margin of the veinlet and the quartz in the centre. The fracturing to which these veinlets owe their origin has been carried so far in many places, as to convert the carbonate rock into a breccia.

Since the carbonate rock occurs, on the north shore of Larder lake, as bands in the slates, phyllites, and greywackes, it might be assumed that it owed its origin to sedimentary deposition in the same manner as the other rocks with which it is there associated. There is, however, an apparent relationship between this rock and the quartz-porphyry and porphyrite of the area which this hypothesis does not explain. In some places the carbonate rock forms well-defined bands within the porphyry, while in other places the two rocks appear to fade into one another. The veinlets of quartz and dolomite which cut the carbonate rock also occur in the porphyry. When examined under the microscope, the porphyry is generally found to contain a considerable amount of carbonate, which, from the brown colour of the weathered surface of the rock, is evidently ferruginous dolomite. In view of these complicated field relations, it has been thought advisable to postpone the further discussion of the origin of the rock until its chemical and petrographical study has been completed. This subject will be fully taken up in the final report on the district, which is now being prepared.

Quartz Porphyry and Porphyrite.—Widely distributed throughout the older Keewatin rocks of the Larder Lake district, and the adjoining portions of Pontiac county, are areas and dikes of intrusive quartz porphyry and porphyrite. In many localities this rock and the greenstone have been so intermingled that their separation on the map cannot be made except in a very approximate manner. It has even gone so far in some places as to produce a rock which on the weathered surface looks like a conglomerate, and hence might be described as autoclastic. The occurrence of dikes of the porphyry in the greenstone, however, seems to prove that it is the younger rock of the two.

Huronian.

An approximately, regular succession can be recognized in the Huronian rocks of this district. At the base there is a conglomerate which passes gradually upward through greywacke into arkose, which in its turn grades into an upper conglomerate. These sediments have been very gently folded into northeasterly and southwesterly synclines and anticlines, the angle of dip averaging about 10°.

The character of the surface upon which the Huronian was deposited in this area was, evidently, not uniform. A very sharply-defined line of junction can be observed in some places; but in other localities, the underlying rock passes insensibly upward through greywacke or arkose into conglomerate. Where the former type of contact occurs, the pre-Huronian rock surface had undoubtedly been subjected to very active erosion; while in the latter case the conglomerate was apparently developed on a surface which had suffered mechanical disintegration to a great depth, but with very little accompanying chemical decomposition.

It will be observed that this series has not been assigned to any particular division of the Huronian, although it is, without doubt, equivalent to the rocks which, elsewhere in the Timiskaming area, have been called lower Huronian or lower and middle Huronian, as described by Dr. Miller in the Cobalt area. There seems to be, however, a reasonable doubt as to whether the relationship of these rocks to the original Huronian of the north shore of Lake Huron is sufficiently well known to permit of such close correlation. In view of this fact they have been, here, described as simply Huronian.

Post-Huronian Intrusives.—The Huronian and older formations described above are intruded, locally, by a considerable variety of rocks: including diabase, olivine diabase, gabbro, porphyry, and lamprophyre. The diabase and gabbro intrusive usually differs from similar rocks occurring in the Keewatin, in its fresh, unaltered character and coarser texture. It has a close resemblance to similar rocks, in the Cobalt area, and is no doubt equivalent to them. To the east of the north end of Lake Opasatika, between Ollier and Renault lakes, the Huronian is cut by a dike of porphyry. It is probable, however, that this is simply an acid, porphyritic phase, of the post-Huronian diabase and gabbro. The lamprophyre occurs, in a series of crumpled dikes cutting sheared conglomerate, on the shore of Larder lake, at Larder City.

ECONOMIC GEOLOGY.

Gold.

The auriferous deposits which have attracted attention in the Larder Lake district and adjacent portions of Pontiac county, during the last few years, may be grouped for the purpose of description into two classes:—

(1) Veinlets of quartz, or of quartz and ferruginous dolomite in carbonate rock and porphyry.

(2) Veins of quartz, or of quartz and calcite.

The first class of deposit is much the more important. The carbonate rock, which in a number of places has a width of 300 feet or more, is usually cut by veinlets of quartz, or of quartz and ferruginous dolomite, throughout nearly its whole mass; so that, although the veinlets are small and irregular, they occur over extensive areas. In several localities, to the northeast of Lake Opasatika and in the vicinity of Larder lake, this type of occurrence has furnished good specimens of free gold, which in some cases assayed from $1,000 to $3,000 to the ton. According to the report of Mr. Morley Ogilvie, who had charge of the mining operations of the Dr. Reddick Company in 1908, a mill run of 100 tons from an open-cut on the Knott claim (H.J.B. 29) yielded from $10 to $12 to the ton. During the winter of 1907, a shipment of 1,500 pounds from the Harris Maxwell sent to the mill at the School of Mining, Kingston, returned $13.20 per ton. On the other hand, during the past summer a run of 230 tons from the same open-cut on the Harris Maxwell averaged 45 cents per ton. Many of the quartz stringers, even where best developed, have been found from assays to contain little or no gold. Samples taken, at 6 inch intervals, across several open-cuts in some of the best showings of quartz in the district, contained only traces of gold when assayed by Mr. Leverin of the Mines Branch, Department of Mines. In one case, an assay of samples from a drift from which some of the best specimens the camp has produced were obtained, gave results of 20 cents in gold and 5 cents in silver to the ton.

The information obtained up to the present with regard to this type of deposit may be summarized as follows:—

(1) The gold values are confined almost entirely to the stringers of quartz, or of quartz and ferruginous dolomite.

(2) The veinlets of quartz, or of quartz and ferruginous dolomite, in many localities, contain no gold, or, if present, it is in insufficient quantities for profitable mining operations.

(3) Locally, this type of deposit carries average values in gold of from $3 to $10 or more to the ton; but in most cases, at least, the ore body is too small to be worked at a profit.

With regard to the future possibilities of some of these prospects, however, further development work and mill tests are required to prove their extent and average value. In the case of the Dr. Reddick, considerable work was accomplished in sinking and drifting on the Knott claim during the past summer, but the rock from these workings has not as yet been tested in the mill. As the surface showings of gold are probably as extensive on this claim as anywhere in the Larder Lake district, the operations now being carried on by the Dr. Reddick Company have a very important bearing on the future of Larder lake as a gold mining camp.

The second class of auriferous deposit has been found in nearly every geological formation of the region. They are usually well-defined veins, from a few inches to several feet in width, carrying small quantities of sulphides such as pyrite, chalcopyrite, galena, and blende, with gold values up to $2 or $3 per ton. The veins of this class occurring in the Keewatin are commonly irregular and of small linear extent; those found in the Huronian and Laurentian are more uniform and continuous.

MINES AND PROSPECTS.

The following are a few of the more important gold prospects in the district:—

Harris Maxwell.—The Harris Maxwell Gold Mining Company holds two claims—H.S. 114, and H.S. 115—on the shore of Larder lake, about half a mile northeast of Larder City. Mining operations, however, have been confined entirely to H.S. 115, the greater part of which is occupied by a hill of siliceous carbonate rock, more or less cut by stringers of quartz and ferruginous dolomite. Rock has been milled from an open-cut on the top of this hill, from a cut on its northeasterly slope, and from a

tunnel about 80 feet in length which enters the hill on the eastern or lake shore side. The equipment on the property includes a stamp mill, and camp accommodation for about 20 men. Development work was begun on the Harris Maxwell in the winter of 1907, and carried on more or less continuously until the autumn of 1908, when the mill was closed down. In August, 1909, work on the property was resumed by the Lucky Boys Mining Company, operating under option, but was discontinued the latter part of September.

Dr. Reddick.—The property belonging to the Dr. Reddick Larder Lake Gold Mining Company, comprises a half dozen claims situated at the eastern extremity of the North East arm of Larder lake. Although some development work has been accomplished on nearly all of these, the more important operations have been confined to the Knott claim—H.J.B. 29—already referred to. The development work completed up to the present on this claim consists of a shaft 83 feet deep, 162 feet of drifting at the 83 ft. level, and numerous test pits and open-cuts, one of the latter being 10 feet wide, 50 feet long, and 15 feet deep. The mining plant installed on the property includes a 20 stamp mill, a compressor, one 80, and two 20 horse-power boilers. Only 10 of the 20 stamps, composing the mill, have been in actual operation, and those for only a very short period in the autumn of 1908. About 150 tons of ore were milled between the first of September and the middle of December of that year, but the work was greatly hampered by frequent breakdowns. Operations on the property since that time have been limited to development work, between 25 and 30 men being employed during the past summer for that purpose.

Gold King.—The Gold King claim—H.F. 140—occupies the eastern portion of the peninsula on Larder lake, to the east of Larder City. The greater part of the rock on the claim is Keewatin greenstone; but on its northern border near the lake shore, there is an area of porphyry cut by veinlets of quartz and ferruginous dolomite, which carry some visible gold. The work done on the claim consists of some stripping, a few small cuts, and a narrow tunnel 30 feet long.

Tournenie.—The Tournenie Mining Company owns a large number of claims in the vicinity of the north shore of Larder lake, including those which formerly belonged to the Larder Lake Proprietary. A stamp mill was erected on one of these claims (C.E. 33) in 1907 by the Proprietary Company, but has never been put into operation. During the summer of 1909, the Tournenie Company confined its efforts to developing its numerous claims sufficiently to comply with the government assessment requirements.

Lincoln Nipissing.—The most important claims owned by the Lincoln Nipissing Development Company are located on a northwesterly-southeasterly band of carbonate rock, which crosses the south half of lot 5, concession VI, Skead township. A very good camp building has been put up, and a boiler and hoist installed on claim C.E. 3. The depth of the shaft was not ascertained, being full of water when visited.

Kerr Addison.—The Kerr Addison claims adjoin the Reddick on the west, and hence are crossed by the same carbonate band as the Knott claim of the Reddick group. Development work has been confined to H.S. 166, and consists of some stripping, a few surface openings, and an adit tunnel 50 feet in length.

Pontiac and Abitibi.—The claims of the Pontiac and Abitibi Mining Company are located about 2 miles northeast of Lake Opasatika, along the north shore of Renault lake. A few test pits and one 30 ft. shaft have been sunk on the property, some of the former being in carbonate rock precisely similar to that on Larder lake. A winter road has been built from Renault lake to Lake Opasatika, and thence to the head of the northeast arm of Larder lake.

Lucky Boys.—A large number of claims in the district are owned by the Lucky Boys Gold Mining Company, but their chief development work has been confined to H.S. 184, and the Chesterville claim situated between H.J.B. 28 and H.J.B. 29 of the Reddick group. Two shafts have been sunk on the Chesterville claim and one on H.S. 184, the maximum depth being about 40 feet. There is also an adit tunnel about 40 feet in length, on H.S. 184, which has been driven into the hill side to connect with the bottom of the shaft.

Silver.

There are two mineral occurrences in the district which may be mentioned under this head, one on B.G. 229, a claim belonging to the North Canadian Gold Mines Company, and the other on the Mageau claims, lot 12, concession V, Skead township. In the first locality, the deposit consists of irregular veins of galena, blende, and chalcopyrite, in Keewatin greenstone. One of these veins has a maximum width of about 10 inches, but pinches out quickly when followed along the strike. The galena is said to carry 60 ounces of silver to the ton. On the Mageau claims, veins of quartz and calcite occur cutting Keewatin greenstone, the calcite, in places, containing galena, blende, and cobalt bloom.

Copper.

A few small deposits of quartz and sulphides of copper—chiefly chalcopyrite—have been located in the district, among which are those on the Copper Queen—H.S. 112; the Quinn claim, on Dushwah (Turtle) lake, and the Renault claim, north of Nabugushk lake. In the last mentioned locality small quantities of native copper have been found.

Cobalt and Nickel.

Cobalt bloom has been mentioned above as occurring on the Mageau claims. Mr. Brock notes its occurrence also in a calcite stringer, on one of the Chesterville claims.

Small deposits of pyrrhotite are of frequent occurrence in the Pontiac schist, one of which, on the east shore of Lake Opasatika, was examined by Mr. McOuat in 1872. A sample was analysed by Mr. Hoffmann of this Survey, and found to contain traces of cobalt and nickel.

SERPENTINE BELT OF SOUTHERN QUEBEC.

(J. A. Dresser.)

INTRODUCTION.

In accordance with the Director's instructions, the past field season was spent in an examination of a portion of the serpentine belt of southern Quebec, between the St. Francis and Chaudière rivers. After a preliminary examination of a part of the county of Brome, where some prospecting for asbestos was being done, and a short visit to some of the asbestos prospects of northern Vermont, I was joined, on June 10, by Mr. A. MacLean, graduate student of Toronto University. Camp was made at convenient places in the district, and work was continued until October 24.

Using the Eastern Townships map—enlarged to a scale of 1 mile to 1 inch—for a topographical basis, the geological mapping was carried on principally by chain and compass surveys. Certain cross sections requiring greater precision were measured by transit and stadia. Material has now been obtained for a preliminary map of the serpentine areas thus far examined.

I am indebted to A. MacLean, B.A.—who acted as assistant for the third year—for most efficient services; to W. J. Messenger, M.A., for valuable temporary assistance; and to the managers of the various mines of the district for many courtesies.

Dr. C. H. Richardson, of the Geological Survey of Vermont, spent several days of his field work in showing me over a section across a part of that State. An opportunity was thus afforded of following the complicated structure of this region from Ordovician to Pre-Cambrian, including the serpentine belt, under most favourable conditions. I must acknowledge with warmest thanks Dr. Richardson's valuable aid and kindly courtesy.

LOCATION AND AREA.

The area examined forms a narrow belt which extends from the St. Francis river in the county of Richmond to a point near the Chaudière river, in the county of Beauce. The northern extremity is near the town of Beauceville, on the Quebec Central railway, about 50 miles from Quebec city. Toward the south the work was carried to Corris station, on the Grand Trunk railway, 81 miles from Montreal, on the main line to Portland. The length of the area examined is about 80 miles, its greatest breadth 8 miles, and the average less than 2 miles.

PREVIOUS WORK.

The first geological examination of this area was made by Sir William Logan, whose work was supplemented by chemical and mineralogical investigations by T. Sterry Hunt, principally between the years 1847 and 1863. The general distribution of the serpentines and associated rocks was ascertained, and their economic importance pointed out.

In the Report of Progress of the Geological Survey for 1880-1-2, Dr. F. D. Adams published the results of a microscopic examination of a suite of specimens of these rocks, and showed that the serpentines are derived by alteration from peridotite, an igneous rock, and not from sediments as had been previously supposed.

Between the years of 1883 and 1886, soon after the beginning of asbestos mining in the district, a re-examination was made by Mr. R. W. Ells, who carried out an extensive revision of the areal geology of the southern part of the Province of Quebec.

In 1905, a monograph by Fritz Cirkel, M.E., was issued by the Mines Branch of the Department of the Interior, which describes the occurrence, uses, and methods of mining and concentrating asbestos. In 1908, a similar volume on the subject of chromite, also by Mr. Cirkel, was issued by the Mines Branch of the Department of Mines.

In 1907, a detailed examination of the serpentine belt was begun for the Geological Survey by the writer, and in 1909 a short paper on the mode of occurrence of asbestos was published in *Economic Geology*, and a somewhat more general one on the mineral resources of the serpentine belt, in the Journal of the Canadian Mining Institute.

OBJECT OF THE PRESENT INVESTIGATION.

The present investigation, which was begun in 1907, was designed to obtain the fullest information possible regarding the geological structure and economic resources of the serpentine belt, with especial reference to the asbestos and chromite deposits. Accordingly, the work of the first season, which was a short one, was principally spent in a study of the character and mode of occurrence of the mineral deposits themselves, and was confined to the mines and their immediate vicinity. The work was suspended during the following year, but was resumed in 1909, when a study was made of the distribution and extent of the mineral-bearing rocks and of the geological features which govern the occurrence of the mineral deposits.

The work is now so far advanced as to permit of issuing a preliminary report and map of the portion of the district which lies between the Chaudière and St. Francis rivers. Further field work is necessary to the south, through the counties of Richmond, Sherbrooke, and Brome to the International Boundary, before a final report can be prepared.

SUMMARY AND CONCLUSIONS.

Asbestos occurs in serpentine of two varieties which are thought to be of different ages. They may be conveniently called the Thetford and the Broughton types, and the rocks associated with them, the Thetford and the Broughton series, from townships in which they are well known.

Asbestos of the Thetford type occurs in veins, and is generally longer and stronger than that of Broughton. Chromite also occurs in the Thetford series. The asbestos of Broughton occurs principally as 'slip' fibre, or fibre arranged parallel to cleavage faces of the rock. It is more cheaply mined than that at Thetford, but being shorter and of less tensile strength it has a lower market value. The Broughton asbestos deposits are often associated with talc or soapstone, which is not found in any important amount at Thetford. There are no deposits of chromite in the serpentine of Broughton.

In both quantity and quality of the minerals produced, much the greater value is obtained from the serpentine of the Thetford type. It forms the greater part of the serpentine belt, and includes the mines of Thetford, Black Lake, and Danville, with much of the intervening areas. It also extends southward beyond the St. Francis river.

The Broughton serpentine contains the mines and prospects of East Broughton and the vicinity of Robertson. The property of the D'Israeli Mining Company, Limited, in Garthby, and some prospects in ranges I, II, and III of Tring, also belong to this class.

The production of asbestos has increased steadily from the beginning of mining in the district thirty years ago to the present. It now has an annual value of $2,500,000.

Chromite occurs in workable deposits in the Thetford serpentine, but not, as far as known, in that of Broughton. The value of the annual production for several years has been about $80,000.

Soapstone, or talc, is found in important quantity associated with the Broughton serpentine, but not with that of Thetford. Some shipments were made from these deposits over twenty years ago, but a stable industry has not yet resulted.

The serpentine of the Thetford class has been derived by alteration from peridotite. The origin of the Broughton serpentine has not yet been satisfactorily determined, but it has doubtless been derived from the same, or from a closely allied rock.

In both cases the original rock was a member of a series of intrusive rocks differentiated from a single magma. The series comprises peridotite, pyroxenite, gabbro, diabase, porphyrite, and hornblende granite, the latter sometimes passing into aplite. The granite has usually been injected a little later than the other members of the series, and, therefore, in many places forms dikes and sills or intrusive sheets. These probably had a favourable influence in the formation of asbestos deposits, especially in the vicinity of Thetford Mines.

The igneous complex takes the form of a batholith, or thick laccolith, in the area between Thetford and Danville, and elsewhere is in sheets or sills. The serpentine of the Thetford type occurs both in sills and batholithic masses, while the serpentine of Broughton is only in sheets or sills.

The different rock varieties are arranged in order of decreasing density: in sills, from the base upwards; in batholithic masses, from the centre outward. This order is peridotite, pyroxenite, gabbro, diabase, and porphyrite. The peridotite alters to serpentine, and the serpentine is purest and so most likely to carry asbestos, near the base of a sill, or the centre of a batholithic mass.

A result of this arrangement of the igneous rocks is, that, when the structure is known, the location of the purest serpentine may be determined. Most of the sheets dip towards the southeast, and in such areas the best prospecting ground is along the northwest side of the igneous belt. Where the sills dip to the northwest, the best prospecting ground is near the southeast border.

In the batholithic bodies serpentine is exposed only by erosion of the original rock masses. This has been most effective on the northeast side of the hills, that being the side against which the ice has moved in the glacial period.

Besides the purity of the original peridotite, which is necessary that pure serpentine may form, the degree of alteration of peridotite to serpentine is an important factor in the formation of asbestos. The degree of alteration is indicated by the relative hardness of the rock. If the original rock were a pure peridotite—that is, composed essentially of olivine—the more completely it is altered to serpentine the softer the resulting rock and the better the prospect for asbestos. But, if the original rock contained a considerable amount of pyroxene which has been altered to soapstone, the resulting rock may be softer than the purest serpentine, but will be unlikely to contain asbestos. Therefore, soft rock is a good indication of asbestos, if there is no soapstone present.

The presence of granite, also, seems to have a bearing upon the occurrence of asbestos veins. The granite rock has generally been injected later than the other rocks; it fills fissures formed in the solid peridotite and forms dikes and sills. Either the fissuring or the action of the granite in filling the fissures has probably aided in forming asbestos.

Since the parent rock of the serpentine was a deep-seated one, and since the alteration to serpentine may occur at great depths, there appears to be no reason why the asbestos deposits also may not continue to as great depths—probably to the limits of profitable mining.

The chromite occurs in segregated masses, that are thought to be primary, in the outer part of the peridotite or serpentine portions of the batholithic masses, near the pyroxenite zone.

Chalcopyrite and pyrite occur in bodies of possible importance, in the diabase of Garthby and other places in the district. They are thought to be primary segregations.

Antimony occurs in South Ham, as a contact deposit in schists, adjacent to serpentine and diabase. The deposit contains native antimony, kermesite, valentinite, and a little stibnite.

Platinum is known to occur in the drift, and this has come from the direction of the chromite deposits, which are the probable source of the metal.

GENERAL CHARACTER OF THE DISTRICT.

Physical Features.

The portion of the Province of Quebec which lies south of the St. Lawrence river consists of two distinct parts, the St. Lawrence plain, and the Appalachian highlands. The St. Lawrence plain, so-called, is really a broad, flat valley, which, since it has an average gradient of scarcely 10 feet in a mile, appears to be a level plain. It extends southeast of the St. Lawrence river for a distance of 50 miles near the International Boundary line, but grows narrower farther down the river, and terminates where the Notre Dame highlands reach the river about 100 miles below Quebec city. The St. Lawrence plain is part of the greater lowland which extends from the lower part of the St. Lawrence river to Georgian bay.

The highlands which form the rest of the Province south of the St. Lawrence are known as the Shickshock mountains, in the Gaspé peninsula; while in the southern part of the Province, or Eastern townships, they are sometimes called the Notre Dame hills. They are a northward extension of the Green and White mountains of New England, and form the most westerly member of the Appalachian mountain system in Canada.

The topography of the district is in an early stage of maturity. The altitude varies from 400 feet to 2,000 feet above sea-level. The relief is characterized by numerous northeast and southwest running ridges and valleys, and a smaller number of larger, transverse valleys.

The transverse valleys are those of the Chaudière, Beçancour, Nicolet, and St. Francis rivers. These rivers all follow northwesterly courses, and empty into the St. Lawrence. It is not yet known whether they are older than the present hills and have cut through the folds as they were formed; or have been superimposed upon them by the removal of later formations, of which remnants are found in the district.

The tributary streams often run in structural valleys, and are probably younger than the main rivers. They generally have narrow valleys with steep sides, and frequently enter the main rivers by distinct falls.

These furnish the principal water-power of the district, and have given rise to such manufacturing centres as the city of Sherbrooke, at the junction of the Magog with the St. Francis; or Windsor Mills, at the entrance of the Wattopekah to the same river.

While the country as a whole is fairly well cleared of timber, many parts of the more rugged surface of the serpentine belt are still densely wooded. In the valley through which the Quebec Central railway runs there is generally a heavy drift covering, which, with the thick second growth that covers the surface for several miles between Coleraine and Thetford Mines, makes detailed work in some places difficult. On the high land and hill tops forest fires have recently exposed much of the surface to view.

Transportation and Communication.

The parts of the district in which the principal mining is done have good railway facilities. The asbestos mines of Thetford, Black Lake, and East Broughton are in no case more than a mile from the Quebec Central railway, and little farther from ship-

ping stations. Most of these mines have sidings, or short spurs connecting the mills with the railway. At Danville, the Asbestos and Asbestic Mining Company, Limited, has built a branch line, about 3 miles in length, connecting the mine with the Grand Trunk railway.

The areas remote from the railways are all accessible by public highways of the ordinary character. The chromite mines are less favourably situated in this respect, but none are more than 7 miles from a railway.

GENERAL GEOLOGY.

The region of southeastern Quebec is underlain by strata of Palæozoic age, resting upon the Pre-Cambrian complex, which emerges from beneath the later rocks a short distance north of the St. Lawrence. The Palæozoic strata form an ascending series toward the south, except where folding and subsequent erosion have disturbed the order of exposure. Every formation from Cambrian to Devonian is represented.

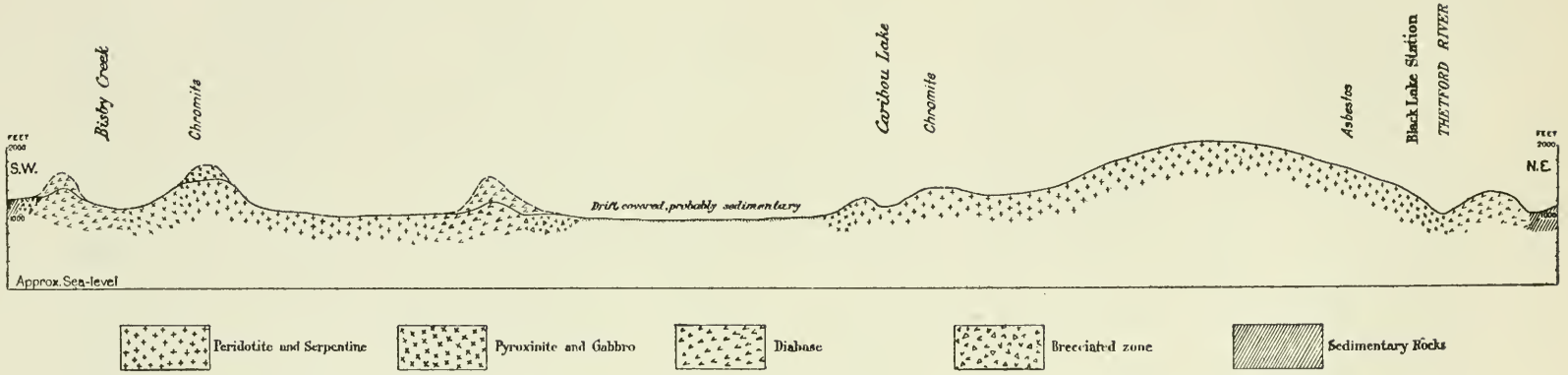
The structure, however, is far from uniform. In the northwestern part of the St. Lawrence plain, the strata are conformable from Potsdam to Hudson River. They are little disturbed in position, and dip toward the southeast at a low angle, usually 5° or 6°. This regularity ends abruptly at the line of the St. Lawrence and Champlain fault, a great dislocation which extends from the foot of Lake Champlain northeasterly to Quebec city and thence to the Gulf of St. Lawrence, running in or near the present channel of the river. On the southeast side of this fault the strata are highly folded, and have otherwise suffered greatly from regional metamorphism. The conditions of deposition were also different. The marine fossil fauna indicate cold, perhaps subarctic, conditions, and an unconformity is found at or near the base of the Ordovician, which is not found on the west side of the fault.

Over considerable areas east of the fault, the folded rocks have been planed down by erosion, so that they now underlie the eastern part of the St. Lawrence plain without expressing their structure in the topography. The sediments of the region consist of shales, limestones, and sandstones, with schists, slate, and quartzites on the east side of the great fault.

The highlands, or Notre Dame hills, consist of three anticlinal ridges running in a northeasterly direction, with two broad, intervening basins, which each have a width of about 25 miles. The ridges are usually distinguished as the Sutton, Sherbrooke or Stoke, and Lake Megantic anticlines. The last forms a part of the boundary line between the Province of Quebec and the State of New Hampshire. The first mentioned is the most westerly of the Appalachian folds in this region, while the second forms the Capelton hills and Stoke mountain, in the vicinity of the city of Sherbrooke, and the hills of Weedon farther to the north.

The ridges contain a considerable development of ancient volcanic rocks, porphyry, and greenstones. These are overlain by sediments, some of which are probably of Pre-Cambrian age.

On the southeast side of the Sutton ridge and closely following its course is the series of basic intrusive rocks which form the serpentine belt. Entering the Province at the Vermont boundary line, they continue northeasterly, with little interruption, to the vicinity of the Chaudière river. They are part of a series of similar rocks which appear at frequent intervals in the eastern part of North America, from Georgia to Newfoundland. In Quebec, they consist of peridotite and serpentine, pyroxenite, gabbro, diabase, porphyrite, hornblende-granite, and aplite, and are regarded as differentiates from a single magma. They form hills 1,500 feet in elevation, covering 10 to 20 square miles in some parts, and in others appear as only narrow bands a few hundred feet wide. In width they rarely exceed 5 miles, and are usually less than 1 mile. In structure they are considered to form batholiths or thick laccoliths, and intrusive sheets or sills.



DIAGRAMMATIC SECTION ALONG POWER LINE OF ST. FRANCIS HYDRAULIC CO, BETWEEN THETFORD RIVER AND BISBY CREEK

Horizontal scale: 1 mile to 1 inch
Vertical scale: 2640 feet to 1 inch

In the area to be described the rocks of the serpentine belt cut no rocks later than Sillery (upper Cambrian), though they probably alter some Ordovician strata. To the south of this district, however, in the county of Brome, they cut Ordovician, and alter strata of Devonian age. It is not yet proven, however, that the rocks of the series were all intruded at or nearly at the same time. The rocks of the district thus far examined appear to be of at least two different ages, and other periods of intrusion may yet be found. Hence the age of the series as a whole can only be determined approximately.

TABLE OF FORMATIONS.

SEDIMENTARY.

1. Quaternary	Sands and gravels. Stratified clay. Boulder clay.
2. Ordovician—Farnham?	Black slates. Conglomerate.
3. Cambrian—Sillery	Red and green slates and sandstones.
L'Islet	Quartzose, grey schists, and quartzite.

IGNEOUS.

(Intrusive, and of different ages.)

Post-Sillery; in part, at least, later than lower Devonian—Thetford Series	Peridotite, altering to serpentine. Pyroxenite, gabbro, diabase, porphyrite, Granite and aplite.
Post-L'Islet—Broughton Series	Serpentine. Soapstone. Greenstone schists.

Sedimentary.

QUATERNARY.

The covering of drift throughout much of the district is heavy. Sands, gravels, and stratified clays are found in all the depressions, and obscure the geological structure, especially in the valley through which the Quebec Central railway runs from D'Israeli to Thetford Mines. In the valleys of the principal streams well marked terraces have often been developed. An especially good example may be seen on the northeast side of the valley in which the road runs from Broughton station to Harvey hill.

No marine fossils have been found in these deposits. In composition they represent complementary parts of the underlying boulder clay, from which they have been principally derived.

The ice movement which has had the most marked effect on the surface of the country has come from the north-northeast, the general course being S 20° W. Another set of glacial striæ running northwest indicates a weaker glacial movement. The former of these ice movements has eroded the northeast side of the principal hills so far as to have an important effect on the exposure of the serpentine.

ORDOVICIAN.

A series of sediments which are near, but not in contact with, the intrusive rocks in this district, consists of graphitic, argillaceous, and sometimes calcareous slates. They are in many places soft and very fissile, and everywhere steel grey or black in colour.

They occupy a large part of the basin between the Sutton ridge and the next to the east, and so appear on the southeast side of the serpentine belt throughout the district, usually at a distance of less than a mile. They occupy the troughs of many of the minor synclines in the underlying sediments, and in such cases generally contain pebbles of earlier sediments. Such outliers approach nearer to the intrusives and may be cut by them, but no such contact has been found. The series is the lowest member of the Ordovician here found, and is tentatively referred to the Farnham series of the lower Trenton formation.

CAMBRIAN.

The rocks which in most places border the serpentine belt are believed to be of Cambrian age. They occupy an area 5 to 10 miles wide, in which is included the outliers and erosive remnants of Ordovician mentioned above. The principal rocks of the series are red, green, and grey slates and schists, sandstone, and quartzite.

Sillery.—The red and green slate and the sandstone are a southerly extension of the Sillery formation of the vicinity of Quebec city and the lower St. Lawrence plain. This formation is regarded by Dr. Ells as belonging to the upper part of the Cambrian system.

L'Islet.—The grey schists and quartzites are lower members of the series. No fossils have been found in them, and no basal conglomerate, or other mark of unconformity, to indicate that the base of the group has been reached. While the rocks are principally sedimentary, some of the grey schists and slates may prove to be altered volcanics.

This formation has been previously called the L'Islet, from its large and well-defined development in L'Islet county beyond the northern boundary of the present district, where it is distinguished by its geographic position and stratigraphic relations, as well as by the lithologic characters of the rocks comprised in it.

STRUCTURAL RELATIONS OF THE SEDIMENTARY ROCKS.

The boundaries between the Ordovician and the Cambrian are usually definitely marked by the conglomerate at the base of the former. This consists of pebbles of the underlying Cambrian sandstone in a matrix of the overlying Ordovician schist. It, therefore, marks an unconformity, indicating a time break between the two formations, and shows this part of the Ordovician to be the base of that system.

The lower limit of the Cambrian is not so well defined. No basal conglomerate, or other certain mark of an unconformity, has been found in this district, and it is a matter of some doubt whether the earlier intrusives of Broughton lie wholly in the Cambrian, or partly in still older rocks.

The strata here described are on the southeast side of the Sutton anticline, one of the major axes of the Notre Dame hills. Consequently the strata have a general dip toward the southeast, with minor folds giving dips in the opposite direction.

The axis of the first important syncline runs across the township of Broughton on lots 21 and 22 or 23. The trough of the syncline in Broughton is occupied by Ordovician strata, while Sillery measures appear at a distance of a mile on either side. The valley in which the Quebec Central railway runs from Thetford Mines to East Broughton is on the axis of the same syncline at Thetford Mines, but some 2 miles west of it at East Broughton. In the southwestern part of the district the structure is not as well expressed in the topography, but the general relations continue the same.

Igneous.

THETFORD SERIES.

The rocks of the Thetford series make up the greater part of the serpentine belt. In this district they extend southwesterly from Broughton mountain, in the township of Broughton, through Thetford, Coleraine, Ireland, Wolfestown, and Garthby to Big Ham mountain. After an interval of 4 miles they reappear in Little Ham mountain, and continue in a southwesterly direction to Danville, and thence to the St. Francis river. Diabase occupies the largest area of any rock of the series, peridotite and serpentine the next. Gabbro and pyroxenite also form considerable masses, while granite and aplite are of relatively small extent.

Peridotite and Serpentine.—Serpentine forms the country rock of all the mines, and, with less altered peridotite, makes up many of the larger hills in the mining district. The hills near Little Lake St. Francis, near Black Lake, in the southern part of Ireland, and between Belmina and Chrysotile, as well as smaller areas in other parts of the serpentine belt, are composed of serpentine and peridotite.

It is difficult, and often impossible, to distinguish these rocks in hand specimens. In the field, and in mining operations, they are collectively called serpentine. The peridotite is composed of olivine, a small amount of pyroxene, and a little chromite and magnetite. The serpentine is merely an altered phase of the peridotite. The mineral serpentine is derived from olivine by a process of alteration, which consists principally of the addition to it of water, and the loss of its iron content. Pyroxene may also alter to serpentine; but it changes less readily than olivine, having originally more silica in its composition; and more frequently it alters to soapstone or talc. The olivine is sometimes completely altered to serpentine, while the pyroxene remains little changed. On freshly broken faces of serpentine, the pyroxene crystals, when any are present, show as glistening grains, usually $\frac{1}{8}$ inch or less in diameter. On weathered surfaces they stand out in relief, giving a rough surface to the serpentine, like raised nail heads, or knots in a worn floor. This is well shown in the rock near the summits of the serpentine and peridotite hills, as, near the top of the hill above Black Lake village.

Pyroxenite.—When pure, pyroxenite consists of the mineral pyroxene. There is usually present, however, more or less olivine or feldspar, the former if the rock is approaching the composition of peridotite, the latter if it tends toward gabbro.

The pyroxenite near the Danville asbestos mines is singularly coarse-textured, and much of it is composed of large pyroxene crystals, some of which measure 2 inches or more upon single faces. In general, the pyroxenite is somewhat altered to soapstone.

Gabbro.—When there is feldspar as well as pyroxene present, the coarse-grained types have been classed as gabbro. It can be distinguished by its coarse texture, shown by angular grains of grey feldspar and green pyroxene. Gabbro forms a large part of the hills above Lac Coulombre, about Nicolet lake, and Little Ham mountains. It may be seen along the roadside near the southeast shore of Black lake, and in many other places near the foot of serpentine hills. The pyroxene is sometimes altered to hornblende; the rock is then more correctly called a gabbro-diorite.

Diabase.—The diabase has the same mineral composition as the gabbro, but is much finer grained, and generally has a quite different appearance. It is a fine, green rock sometimes showing small, grey grains of feldspar. In other cases no individual mineral can be distinguished by the unaided eye. The rock can often be readily recognized by nodules and stringers of yellowish-green epidote, a mineral that has been formed by the alteration of feldspar, and, in part, also of pyroxene. There is frequently a little quartz with the epidote.

Diabase may be well seen along the Quebec Central railway between Black Lake and Thetford Mines; also near the Roman Catholic church at Black Lake. It forms the hills about Clapham lake, and near the Little Nicolet lakes. It carries copper and iron pyrites, in places, as at Lac Coulombre. In places, the diabase, by becoming more acid in composition, and losing much of the pyroxene, passes into porphyrite near the outer edges of the mass.

Granite.—The granite in this area is composed of feldspar, quartz, and hornblende or mica (biotite), or both. It is light grey in colour, and occasionally shows a pinkish tint. Portions without hornblende or mica—principally dikes—are more properly classed as aplite.

The granite is in small amount in the district, but is important, as it probably indicates conditions that favoured the development of asbestos. It forms hills in the northeastern part of Coleraine, dikes in most of the mines, and, in places, isolated masses grading into the enclosing diabase or porphyrite. These isolated masses are, probably, primary segregations.

Structural Relations.

(*a*) *External.*—The rocks of the Thetford series are very obviously intrusive in their relations to the enclosing sediments. Evidences of this are: alteration of the sediments in the outer contact zone; deflexion of their dip and strike; and developments of contact breccia.

The alteration of the sediments is sometimes shown by a hardening of a band near the contact, producing a hornstone rim. The grey slates are often given a rusty, reddish colour, due apparently to the oxidation of sulphides developed near the contact; while the originally red Sillery slates are usually bleached to pale pink. Fragments in the breccia, and larger portions of sediments near the contact, show partial absorption by the igneous magma. Some of these rocks still preserve the lines of foliation of schists on weathered surfaces, but on freshly broken faces they cannot be distinguished from the enclosing, or adjacent, igneous rock.

Dikes are very rare, and altogether there is a very noticeable absence of evidence of any violent eruption. The intrusion seems to have progressed slowly, and without any marked cataclysmic action. The contact is thus of the batholithic type.

The bodies of igneous rock appear to take two principal forms. From Broughton mountain to Little Nicolet lake, where the igneous belt crosses the stratification somewhat obliquely, the intrusions occupy elliptical or rounded areas, bordered by breccia, and giving evidence of downward enlargement. With the exception of one district, and two doubtful intervals, they form a continuous mass, and so are interpreted as being a batholith, or very thick laccolith.

In other parts of the district, the boundaries of the intrusions conform more closely to the stratification, are generally brecciated on one side only, and occupy long narrow areas. In cross section they can sometimes be seen to form sills or intrusive sheets, and are consequently considered to more generally take this form.

(*b*) *Internal.*—The peridotite, pyroxenite, gabbro, and diabase, form a continuous series, passing by gradual transitions from one variety to another in the order named. In the case of larger exposures, all of these rock types can sometimes be found in a single intrusive mass. In other cases, the differentiation is sharper, and peridotite passes into diabase with only a few feet of transitional rock between. In general, peridotite, or the serpentine derived from it, and diabase, form the larger portion of a rock mass. At the outer edges, the diabase, in places, passes into hornblende porphyrite, and this occasionally into hornblende granite, or aplite.

The granite and aplite have usually, however, been intruded a little later than the more basic rocks. The edges of these acid intrusions are generally as well crystallized as the central parts, showing that they were brought in while the basic rocks were still

heated. Occasionally, too, an injection of diabase has taken place somewhat later than the intrusion of the greater part of the mass. This may be seen at Louise mountain, in Garthby, and probably near Shipton Pinnacle, but such occurrences are not common.

The rocks of this igneous complex are generally distributed in one or other of two different modes of arrangement, according to the form of the igneous intrusion. They are arranged in order of decreasing basicity and density:—

(*a*) In sheets from the base upwards.

(*b*) In batholithic intrusions from the centre outwards. Serpentine, or diabase, may sometimes be much in excess of the other rocks, and thus give an asymmetric arrangement. But the more acid rocks, wherever present, are, as far as known, invariably nearest the tops of sheets or the margins of batholithic intrusions, and the basic rocks in correspondingly opposite positions.

In the case of sheets, the arrangement of the rocks accords with the relative densities of the principal minerals of which they are composed, and also with the order of their crystallization.

In the case of batholithic intrusions, the differentiation from basic to acid extremes, from the centre outwards, is in agreement with well known cases of magmatic segregation in intrusive rocks where differentiation has taken place prior to intrusion. The igneous complex of Magnet cove, Arkansas, is a parallel in alkaline rocks.[1]

An instance is given by Mr. Chas. Camsell (see Mr. Camsell's Summary Report in this volume) of a volcanic stock from the platinum locality in the Tulameen district of British Columbia, where a core of peridotite is bordered by a differentiated rim of pyroxenite. An adjacent intrusion of augite syenite took place a little later.

The batholithic intrusions near Thetford characteristically consist of a dome-shaped central mass of peridotite, bordered, or sometimes nearly surrounded, by an erosion valley. The outer side of the central mass is formed by a ridge of diabase, or porphyrite, which passes into breccia at its outer edge. These fractures can be seen in a section extending from the top of the hill above Black Lake station, which is part of the central dome, to the valley of the Thetford river, and thence to the diabase at the Roman Catholic church in the northern part of the village. (See diagram, page 185.)

BROUGHTON SERIES.

The Broughton series consist of serpentine, soapstone, and greenstone schists. They are the rocks containing, and adjacent to, the asbestos and talc deposits of Robertson, East Broughton, and Broughton, and of several isolated locations in the vicinity.

The rock differs from that of Thetford and Black Lake, in being much softer and more shattered. It is almost completely serpentinized, the only exception being certain hard blocks which carry no asbestos. The asbestos that is recovered here rarely occurs in veins, but generally as slip or parallel fibre, being, in fact, only the softer and partially fibrous, outer portions of the individual pieces into which the rock is shattered. A microscopic examination of these rocks is still necessary in order to determine the actual mineral composition of these hard blocks, and to find out, if possible, whether the asbestos-bearing portion was originally similar to that in the Thetford series. The presence of considerable bodies of talc, and steatite or soapstone, indicates that there was a good deal of pyroxene in the original rock. There is very little chromite in the serpentine of this class.

The altered greenstones are chloritic and epidotic schists, which probably were originally diabase, together with hornblende schists which grade into them. The latter

[1] Washington, H. S., 'Igneous Complex of Magnet Cove.' Bulletin, U.S. Geol. Surv., Vol. XI, pp. 389-416, 1900.

may be the altered, more acid parts of the primary rock, perhaps corresponding to the porphyrite of the Thetford series. The precise character of these rocks can only be determined by detailed lithological examination, which has not yet been made.

The greater alteration of these rocks indicates that they are earlier in age than the Thetford series. The rocks enclosing them are the grey schists and quartzites—in no case the red slates, of the Sillery formation. It can, therefore, only be said of their relations that, they are intrusive in, and hence later than the L'Islet formation which conformably underlies the Sillery.

ECONOMIC GEOLOGY.

The minerals of economic value that have been found in the serpentine belt are asbestos, chrome iron ore, talc, antimony, copper, and platinum. Of these, asbestos and chrome iron ore are at present being mined; the former constituting in value one-half of the total mineral production of the Province of Quebec, and producing upwards of 80 per cent of the world's supply of asbestos. Antimony and talc have been mined; there has been a small development of the copper ore; and platinum has been found in the gravels.

Asbestos.

History.—The discovery of asbestos in commercial quantities in this district dates from 1877, although it was known for many years previously as a mineral occurrence of prospective value. Mining operations began at Thetford, Black Lake, and Danville very shortly afterwards, and have continued ever since. Since the introduction of a successful method of mechanical concentration, about 1893-4, the production has increased regularly, until it now has an annual value of $2,500,000. Notwithstanding this steady and increasing production, no well-established mine has yet been worked out. Aside from the abandoned pits incidental to early prospecting, the only closed works are those of ill-judged enterprises that probably ought never to have been begun.

The production for the past four years has been as follows:—

	Tons.	Value.
1905	50,669	$1,486,359
1906	60,761	2,036,428
1907	62,130	2,484,767
1908	66,548	2,555,361

In addition to this, there has been produced 'asbestic' to the value of $17,974 during the past year.

The asbestos is of the chrysotile variety—hydrous silicate of magnesium—and has the same chemical composition as the serpentine rock which contains it, but is distinguished from it by its fibrous form.

Character of the Veins.—In the Thetford-Danville section, the asbestos occurs almost wholly in veins which are usually 2½ inches or less in width, the greater number being less than ½ inch. The fibres lie at right angles to the walls of veins, hence the length of the fibre is limited by the width of the vein; but it rarely equals it; for there is usually a parting in the vein which is marked by a film of iron ore, generally magnetite. The veins are invariably bordered by a band of pure serpentine on each side of the vein, whether the country rock be a serpentine or partially one, or even a slightly altered peridotite. These serpentine bands bordering the veins are usually as well defined as the vein itself, and in width are proportionate to it, each being nearly three times the width of the asbestos vein.

From a consideration of these facts, and of the number, size, and directions of the veins, it is believed that they were formed not by the filling of once open fissures, but by the replacement or crystallization—more or less perfect—of the pure amorphous

serpentine of the side walls. This process is thought to have begun at a fracture now indicated by the parting or film of iron ore within the vein, and to have extended into the wall rock on one or both sides to a distance proportionate to the width of the serpentine bands. They thus belong to the class of veins sometimes called oxogenous or *outward* growing, as distinguished from those that are formed by filling a fissure from the edges *inward*. Measurements of many veins have been made, which show the proportion of asbestos to the two bands of serpentine and the included asbestos to be 1:6·6, or that approximately 15 per cent of the serpentine has taken the crystalline form of asbestos.

Origin of the Fractures.—In the Thetford or later serpentine many of the larger veins can be seen to follow joint planes in the original rocks. Another class seems to have grown from fractures caused by regional folding, as is indicated by their approximate parallelism. Fractures produced in early stages of disintegration of the rock by casting off shells from the jointed blocks give a series of crescent-shaped veins, surrounding a core of peridotite. Where all of these classes of veins are found together there results a very intricate network, but by careful observation many of them can be referred to one or other of these classes.

In the supposedly older serpentine of East Broughton there are comparatively few veins. The exact mode of occurrence of the asbestos in this rock has not yet been studied in detail, but the asbestos seems to occur as 'slip' or 'parallel' fibre, which is on or in the rock, parallel to cleavage faces.

Other causes of the shattering of the rock, such as hydration, rapid cooling, and, possibly, original gneissic structure near the edges of an intrusion, require a full investigation covering the entire process of serpentinization.

Mining.—All the mines are worked by open-cut methods. The ground at the bottom of the pit is usually cut into a series of benches, generally about 8 to 15 feet high, which afford a number of faces from which the rock can be quarried at the same time. At the Bell mine, Thetford, extensive underground work has been carried on in winter with apparent success. Generally, the mines are operated only by day. At the King mine, Thetford, work is carried on in the pit at night by the aid of search lights. At the Danville mine, some underground work was carried on by night during the last summer. Several of the pits have reached a depth of about 200 feet, with two or three times greater horizontal extension.

Handling and Dressing.—In some of the mines the asbestos-bearing portion is separated from the barren rock in the pit, and in part the crude from the mill stuff, and each is loaded into separate boxes and hoisted to the surface. A certain amount of hand cobbing is also done in some pits. In most, however, all hand separation is done at the surface. There, the separate products are emptied into tramcars, which are usually drawn by small locomotive engines; the dead rock is then taken to the waste dump, and the rock which will afford crude asbestos, to the cobbing sheds, where it is separated by hand work and put in bags. The remainder, usually 35 per cent to 60 per cent of all the rock handled, goes to the ore bins, or, in some cases, directly to the mill for mechanical concentration.

This concentration is an ingenious process, which has been developed by some of the pioneer mine managers of the district. The essential features are successive crushings and screenings of the rock, and the removal of the asbestos thus liberated by means of suction fans. The crushing is effected by jaw and rotary crushers of the standard type, and a finer crushing is frequently effected by means of rolls. After the first crushing much or all of the material is dried in rotary driers, with direct heat.

A final pulverizing of the rock is accomplished by a specially designed machine known as the cyclone. This consists of two 'beaters,' or heavy screw propeller-like fans of chilled iron, set end to end, which revolve at a speed of 2,000 revolutions per

minute, or more, in opposite directions in a closed chamber. The small rock fragments are thus driven together with such force as to reduce them to powder, and the smallest particles of asbestos are released and collected as before.

The fibre drawn off at the various stages of the milling process is collected in settling chambers, and conveyed to a rotary classifier, by which the product is separated into various grades according to the length of the fibre.

Suction fans for the removal of dust from the cyclone, the classifier, and sometimes from the mill are important accessories to the equipment. Magnets are usually employed over the shaking screens to eliminate particles of iron ore.

The various mills differ from one another in details, some of which are regarded as more or less secret features, but the general practice is essentially uniform. The milled fibre is classified into three or more grades, and the crude asbestos usually in two. The question of adopting a standard classification is being discussed.

Prices.—The following production by classes, as compiled by Mr. J. McLeish, Chief of the Division of Mineral Resources and Statistics, of the Mines Branch, Department of Mines,[1] shows the proportions of different grades, classified according to value:—

——	Short tons.	Value.	Range of price per ton.	Average price per ton.
		$	$ cts. $ cts.	$ cts.
Crude No. 1	857½	257,752	267 00 to 350 00	300 59
" No. 2	2,488	411,480	75 00 to 225 00	165 38
Mill Stock No. 1	5,282½	425,448	60 00 to 100 00	80 54
" No. 2	45,545¼	1,345,750	20 00 to 50 00	29 33
" No. 3	12,374¼	114,931	5 00 to 13 00	9 29
Total Asbestos	66,548	2,555,361	5 00 to 350 00	38 40
Total Asbestic	24,225	17,974	35 to 1 16	74
Grand Total	90,773	2,573,335		

Uses.—A small proportion of the asbestos produced, all of the highest grades, is used in making asbestos cloth and various fire-proof textiles; while much the greater part is used for covering, and insulation purposes. Boards, shingles, and roofing felts for fire-proof construction, materials for electric insulation, and protection from acids, boiler and pipe coverings are among the products in common use.

The manufacture of asbestos goods has hitherto been carried on practically only in Europe and the United States. During the past year, however, a plant for the manufacture of asbestos shingles, mill-boards, and covering material has been established at Lachine, Quebec, by The Asbestos Manufacturing Company, a Company allied to the long-established manufacturing firm of Keasbey and Mattison, of South Ambler, Pennsylvania.

Mines.—A list of the mines, with more or less detailed description of their equipment and capacity, as well as their financial organization, has been published in the Report of the Mining and Metallurgical Industries of Canada, issued by the Mines Branch of the Department of Mines, in December, 1908, and hence need not be repeated here. The following are the mines that have produced asbestos during the

[1] 'The production of Asbestos in Canada,' 1907-8, by John McLeish. Mines Branch Publication No. 44.

past year, and all in operation at the close of the summer. They are named in order of location, and the names of the owners and of the shipping stations are also given:—

King: Owners, The Amalgamated Asbestos Corporation, Thetford Mines, Quebec Central railway.

Bell: Owners, Keasbey & Mattison, Thetford Mines, Quebec Central railway.

Johnson: Owners, The Johnson Asbestos Company, Thetford Mines, Quebec Central railway.

Beaver: Owners, The Amalgamated Asbestos Corporation, Thetford Mines, Quebec Central railway.

Union: Owners, The Black Lake Consolidated Mining Company, Black Lake, Quebec Central railway—re-opened late in the season.

Johnson: Owners, The Johnson Asbestos Company, Black Lake, Quebec Central railway.

British American: Owners, The Amalgamated Asbestos Corporation, Black Lake, Quebec Central railway.

Danville: Owners, Danville Asbestos and Asbestic Company, Danville, Grand Trunk railway.

Standard: Owners, Amalgamated Asbestos Corporation, Black Lake, Quebec Central railway.

Dominion: Owners, Amalgamated Asbestos Corporation, Black Lake, Quebec Central railway.

Robertson: Owners, Robertson Asbestos Mining Company, Thetford Mines, Grand Trunk railway.

Broughton: Owners, Broughton Asbestos Fibre Company, East Broughton, Quebec Central railway.

Eastern Townships: Owners, Eastern Townships Asbestos Company, East Broughton, Quebec Central railway.

Quebec: Owners, Ling Asbestos Company, East Broughton, Quebec Central railway.

Frontenac: Owners, Frontenac Asbestos Mining Company, East Broughton, Quebec Central railway—equipped late in the season.

Properties under Development.—The Thetford Asbestos Company, about to be reorganized as the Jacobs Asbestos Company, has done some development on lot 28, range VI, of Thetford, with promising results. The construction of a mill has been begun, and the property is likely soon to be an important producer.

On the property of the Imperial Asbestos Company, a short distance south of Black Lake station, some development has been done by the Black Lake Consolidated Company, and it is announced that a mill is to be built. On the Southwark property, lots 27 and 28, range B, of Coleraine, the same Company made some very successful developments, and propose operating the property in conjunction with the Union mine, which it adjoins. A new mill is to be built to serve both properties.

The adjacent property of Dr. James Reed, in range A, Coleraine, which has had considerable development, and is partially equipped with a mining plant, has remained unused for some time.

The King property, lot 26, range III, of Ireland, and the Belmina, lots 23, 24 and 25, range II, of Wolfestown, are also partially developed properties which have not been recently worked. Both seem to give promise of favourable development.

The D'Israeli Asbestos Company has built a mill on lot 16, range III, of Garthby, and upwards of 4 miles of track to connect it with the Quebec Central railway, and is now preparing to develop the property.

At lot 24, range IV, of Wolfestown, an extensive mining and concentrating plant was installed a few years ago by the Asbestos Mining and Manufacturing Company, of Providence, Rhode Island. But the development of the property proving unsuccessful, the plant has been partially dismantled after lying idle for two years, and the property has lately changed hands.

At the Boston Asbestos Company's property, East Broughton, a mill has been built, and some development work done on a property adjoining that for which the mill was built. The mill and mine were not in operation at the time of our visit.

In lot 9, range V, of Thetford, the Beaudoin and Audet Company has done some development, as has also the Berlin Asbestos Company on lot 2 of the same range.

In lot 14, range VII, of Broughton, the old Fraser mine, once celebrated for the remarkable quality of the asbestos produced from a single vein, remains unworked. There seems likely to be a workable quantity of lower grade fibre in this property.

In all the mines of East Broughton the principal work has been done near the hanging-wall or top of the serpentine sheet, and the opinion prevails that the lower portion, that is the northwest side of the serpentine, is unproductive. The rocks of this locality have not yet been examined microscopically and chemically, hence, comparison is difficult. But in the rocks of the Danville sheet the best serpentine is at the north side, or near the foot-wall.

It would, therefore, seem advisable to test the serpentine at East Broughton near the northern edge, where asbestos, if it occurs at all, is more likely to be in well-defined veins and of greater tensile strength.

Prospects.—Asbestos has been found in various places in the district, by prospecting at different times, where little or no work has been done. In the East Broughton district, lot 13, in ranges III and IV, serpentine-bearing asbestos is shown by pits or natural exposures for a distance of several hundred feet in each range. The access to the railway is somewhat less easy, but the quality of the rock seems to compare favourably with that of the working mines at East Broughton.

Southwest of the mines of East Broughton, serpentine is found on lot 13, in ranges VIII and IX, of Broughton. In range IX it passes into lot 12, about 600 feet from the north end of the lot, and next appears near the northeast end of lot 11, in range X. From this point the serpentine appears at frequent intervals in two sheets running in a northwesterly direction to lot 2, in range XI. This change of direction in the outcrops of serpentine is caused by an arching of the strata across the strike, which gives the rocks a low northeasterly pitch, instead of a southeasterly dip. Consequently some parts of these serpentine sheets have a nearly horizontal roof of slate, and will be unavailable, since both the serpentine and the slate are too much fractured to admit of underground work, even if the prospects otherwise warranted it.

On the southwest side of this arch the serpentine is again found on lot 12, range XI, of Broughton; and in lots 1, 3, 10, 11, and 13, in range V of Thetford. Lots 2 and 9 in this range contain the properties of the Berlin Asbestos Company, and the Beaudoin and Audet Company, respectively, already mentioned; while the Robertson mine is situated on lots 16 and 17, in range XIII. The occurrence of serpentine on lot 13, range V—the property of Dr. James Reed—has led to some development work which seems to indicate that the rock is fairly productive in asbestos of the East Broughton or older type.

In lot 24, of ranges I, II, and III, of Tring, a small amount of serpentine is exposed, which contains a little asbestos. A very small amount of work was done here twenty years ago. The Tring branch of the Quebec Central railway cuts the serpentine near the line between ranges II and III.

Near Thetford Mines, prospecting was pushed on the Clarke property, lot 24, range A, Coleraine, and some work was also done on lot 27, range VI, of Thetford, by Jos. Demers and others.

The property in block B, Coleraine, formerly owned by the Coleraine Mining Company, but now belonging to the Black Lake Consolidated Company, is not being worked. A little prospecting was done near Coleraine during the past summer on lots 35 and 40, range II, of Garthby, and on lot 2, range VI, of Coleraine. No very definite results had been reached at the time of our visit.

South of the road from Coleraine to Wolfestown, several properties along the Belmina hill, chiefly in lots 23, 25, and 26, of ranges III and IV, show a little asbestos, but they have, generally, been little prospected. In lot 13, range VI, of North Ham, there is a small knoll of serpentine, on the south side of which there is a perpendicular face about 25 feet high. On part of this cliff face, about 15 x 20 feet, several veins of asbestos from 1 to 2 inches in width, and of excellent quality, are exposed. A small cutting on the top of the cliff did not show the veins to extend beyond a foot from the face of the cliff, while four small pits on other parts of the knoll did not disclose any veins of asbestos. The serpentine, which is several miles from any other known exposure, has a maximum breadth of 350 feet, and can be traced upwards of 1,000 feet on this property, and is recently reported to have been found to extend to lot 11 in range V. In view of the excellent quality of the small amount of asbestos exposed, it is to be hoped that the property will be thoroughly tested.

In range XI, of Tingwick, lots 20-25, there is a considerable area of serpentine, which has not been well prospected owing to the thickly wooded character of the area. Near the boundary of lots 21 and 22, the property known as the Ladysmith mine has had some development and equipment, including an extemporized mill. Work was closed at the time of our visit in July. There are other prospects between this property and the shore of Nicolet lake; but practically no work has been done upon them.

On lot 10, range III, of Shipton, adjoining the mine of the Danville Asbestos and Asbestic Company, the presence of asbestos-bearing serpentine beneath several feet of soil has been proven by a shaft. The question of economically utilizing the property at present has been further complicated, if not rendered impossible, by the sale of a portion of it in small building lots to several different owners.

A band of serpentine extends from the Shipton Pinnacle to the St. Francis river, a distance of 8½ miles. It occupies a part, or all, of lot 10, range VII, and lots 8 and 9, in range VIII, of Shipton; and in Cleveland, lots 8 and 9 in range IX, 7, 8, and 9 in range X, 7 and 8 in ranges XI, XII, and XIII, 6 and 7 in range XIV, and 6 in range XV. The northwestern edge of this band is a soft, but generally massive serpentine, and asbestos up to 1 inch in length has been found in several places. This is the largest unprospected or little prospected area in the district. It is not to be confused with a series of isolated outcrops of serpentine which are found nearly a mile to the northwest of the main band, running through lots 9, 10, and 11 in Cleveland, and 12 in Shipton. These are usually composed of a harder and less promising variety of serpentine; but on lot 12, range V, of Shipton, where it is associated with granite, one of these outcrops of serpentine contains a limited amount of asbestos.

Chromite.

Chromite, or chrome iron ore, is an oxide of chromium and iron. It is useful not as an ore of iron but for its content of chromium.

Various attempts to mine this ore in Quebec were made between 1860 and 1890, but it was not until 1894 that any considerable production was made. Since that date over 400,000 tons of chromite have been mined, which had a value at the railway of about $600,000. The production for the last four years has been as follows:—

	Tons.	Value.
1905	8,528	$104,565
1906	8,750	92,100
1907	7,196	72,901
1908	7,225	82,008

Mode of Occurrence.—The ore is in irregular masses, sometimes having the shape of flattened lenses. The largest single body of ore known in the district is 80 feet long x 5 feet to 50 feet wide, and has been proven for a depth of 300 feet or more.

Chromite in disseminated grains is found throughout practically all of the serpentine and peridotite; but in quantities large enough to form ore bodies it has been found principally in the peridotite near its outer edge, that is, close to the pyroxenite margin. The Dominion pit of the Black Lake Consolidated Company is at the southeast edge of the serpentine, and some 200 feet from diabase. The intervening ground is drift-covered, as is commonly the case in that portion of the batholithic masses. The American mine is on the northwest edge of the same mass. The Caribou pit, and the Black Lake pit No. 1, are near the southwest edge of the peridotite, where the latter carries considerable pyroxene. The Canadian Chrome Company's mine is on the southeast side of the same mass as the Caribou and Black Lake. The Breeches Lake or Leonard property, in Garthby, is on the south side of a serpentine hill with the acid rocks running around the foot, while the St. Onge, Adam, and Brosseau properties are similarly situated with regard to the serpentine hill northeast of D'Israeli.

The masses of ore are separated from one another by bands of rock of varying thickness, which makes regular production difficult. The ore occurs in a zone, that can probably be defined by a study of its place in the rock series; but this involves more detailed examination and mapping than has yet been found practicable.

Mining.—Mining is carried on in open-cuts, except at the Black Lake pit No. 1, where a shaft has been sunk. As the ore bodies are often small and discontinuous, the least expensive methods of working have usually been adopted. Power drills and derrick hoists are the principal equipment used. The diamond drill has been used successfully for prospecting.

Concentration.—The ore is bought and sold on a basis of 50 per cent chromic oxide. If higher than this, a premium is paid, if lower the ore is penalized. Consequently ore carrying approximately 40 per cent is shipped as crude; all from that quality to about 10 per cent is concentrated to 50 per cent or a little higher. The highest percentages reached in either crude or concentrated ore is rarely above 55 per cent, $Cr_2 O_3$.

The method of concentration that has been followed recently consists, successively, of crushing, stamping, and concentrating by means of Wilfley tables. The middlings from the first Wilfley's are usually treated on a second table, and a product rarely exceeding 51 per cent or 52 per cent is obtained. No data is at present at hand as to the percentage of recovery. There is, however, an apparent loss in 'float,' or very finely crushed ore, which is carried from the tables with the lighter rock particles.

Uses.—A limited quantity of these ores was used for a time by the Electric Reduction Company of Buckingham, Quebec, in the manufacture of ferro-chrome. Except for this, and occasional small shipments to Europe, the Canadian production is shipped to the United States. It is there used in the manufacture of bichromates for use in dying textiles, tanning leather, for pigments used in printing and painting, and in making chrome steel, and the lower grades for lining furnaces.

Antimony.

The only occurrence of this mineral that is yet known in the district is in range I of South Ham, lot 28 of the old, or 56 of the later numbering, on the property of Dr. James Reed, of Reedsdale, Province of Quebec.

The ores are native antimony, with less amounts of stibnite, kermesite, and valentinite. The deposit is said to have been found in 1863, and to have been soon after developed and equipped with a mining and concentrating plant. After a time the works closed, and the property passed into the hands of the present owner.

The development, as far as could be made out in the present state of disrepair, consisted of four shafts. An adit, which could not be entered at the time of our visit, starts at a lower level some 300 feet from the main shaft, and is said to reach it at a depth of 100 feet. Considerable drifting is reported to have been done along the length of the ore body.

Character of deposit.—This is a contact deposit, in which the ores occur in schists along their contact with an intrusion of diabase and serpentine. The schists strike N 50° E magnetic, and have a vertical dip. A serpentine ridge runs east and west. The serpentine just north of the main shaft is exposed for about 150 feet in length, east and west, and has a breadth of 75 feet. It is bordered by diabase on the west and northwest sides, but on the southwest comes directly in contact with the slates of which it contains fragments. The principal workings are at the south contact of the serpentine with the schists, with one small shaft on the northwest side of a similar hill, about 1,000 feet east of the mouth of the adit. As these two intrusions of serpentine are doubtless connected at no great distance beneath the slates, it is not improbable that antimony may be found in the intervening distance. On the other hand, this structure lessens the probability of the deposit continuing to a great depth.

No distinct veins of any considerable width could be found in the present state of the workings, but the principal amount of ore seems to be in flakes, along the cleavage planes of the schists. The proportion of ore becomes greater as the contact is approached.

Two specimens of antimony ore from this property which have been assayed for gold by Mr. H. A. Leverin, of the Mines Branch, yield only a trace.

Talc.

Steatite or soapstone—as well as the purer forms of talc—occurs in numerous places in the townships of East Broughton, Broughton, and Ireland. It generally bears the same relation to the older serpentine that pyroxenite has to peridotite. It is an altered form of pyroxenite, and in some places shows distinct pseudomorphs of steatite after pyroxene.

Soapstone has been quarried to a small extent at the old Fraser mine, East Broughton, lot 14, range VII, and on lot 5, range V, of Thetford. A considerable quantity is easily available on lot 2, range XI, of Broughton, and Ham, lots 42, 43, and 50, range I.

A better quality of talc is found on the farm of W. I. Porter, lot 2, Craigs Road range of Ireland, where it probably occurs in workable quantity.

Platinum.

A small amount of platinum was reported to have been found in the gravels near the Chaudière river, in the county of Beauce, by T. Sterry Hunt, in 1852. The natural habitat of platinum is in chrome-bearing peridotites. These gravels are 30 miles southeast of the serpentine belt, and it is altogether probable that they have been in part derived from it. A nugget of platinum has also been found at Plattsburg, N.Y., some 50 miles south of the serpentine belt in Brome. In the Tulameen district of British Columbia, Mr. Camsell finds the platinum to occur with the chromite. Two specimens of chromite from Black lake, which have been assayed by Mr. H. A. Leverin, Mines Branch, Department of Mines, have yielded no platinum.

Copper.

Chalcopyrite is found in small quantities, apparently as primary segregations, near the outer edges of the diabase in many places in this district. Most of them, however, are mere mineral occurrences, and not of commercial importance.

On lot 22, range I, of Garthby, is the property known as the Coulombre mine, on which a shaft was sunk over forty years ago. The ore is a compact pyrite carrying a small copper content. It is extremely free from silica, and should be useful in conjunction with some of the siliceous copper ores of the Capelton district.

While there is little facility for finding the limits of the ore body, the extent over which isolated exposures are found indicates the possibility of an important ore body: perhaps like one of those found under similar conditions to the southwest of this district, at the Huntingdon and Lake Memphremagog mines.

Smaller amounts of a better grade copper ore occur near the north shore of Clapham lake, on lot 15, range VIII, of Thetford. This is also in diabase near the contact with slate.

In lots 8 and 9, range I, of Wotton, diabase carries a little disseminated pyrite over an area of some 20 acres. It is possible that by stripping the soil from the rocks the ore might be found to be concentrated in places, into workable deposits.

OIL-SHALES OF EASTERN CANADA.

(R. W. Ells.)

INTRODUCTION.

The work of the past season was largely in connexion with the oil-shales of eastern Canada, and was a continuation of that of the previous year. The extent, distribution, and economic value of the oil-shale deposits of New Brunswick, Nova Scotia, and Gaspé were ascertained as carefully as was possible in the time available. Collections of samples were made from various points in the several provinces where such shales are exposed, and these were examined by Mr. H. A. Leverin in the laboratory of the Mines Branch, Department of Mines, at Ottawa. In this way their contents in crude oil and sulphate of ammonia were ascertained.

OIL-SHALES OF NEW BRUNSWICK.

In the following account of the season's work, the various areas of oil-shales in New Brunswick are treated in the order in which they were visited. The first to be described is that of the Albert shale series of Albert and Westmorland counties, as found in an area situated about 30 miles from the Intercolonial railway, and extending from Memramcook and Upper Dorchester on the east nearly to the western line of Albert county, with a breadth varying from 1 to 6 miles. Farther west the formation is found in Kings county, between Sussex and Bloomfield, south of the Intercolonial railway. These several areas have been described in former reports on the district, and are all easily accessible.

At Albert Mines, which, in so far as mining is concerned, is the most important oil-shale area of New Brunswick, and is distant about 20 miles by road south of Moncton, large samples of the several varieties of oil-shale were collected, sent to Ottawa, and carefully analysed. The results of these analyses will be found under the heading, Albert Mines.

Thence, the examination extended eastward past Hillsborough and across Petitcodiac river to the Memramcook, where the village of Taylorville, easily accessible from Dorchester, is located. Here, also, samples of the black, oil-shale bands were collected, and, on being tested, were found to be very high both in crude oil and ammonia; the results of the analyses will be found under the head of Taylorville shales. Returning by way of Memramcook and Dover, other collections were made near Dover, mostly in somewhat thin shales which, however, were of good quality. The results of the analyses of these shales are given under the head of Dover shales.

Returning thence to Albert Mines, the areas westward were further examined, and specimens obtained at most of them, or wherever—according to our field test—the quality of exposed shale seemed worthy of further examination. These areas, in their order westward from Albert Mines, are: Baltimore, Turtle creek, Prosser brook, Pleasant Vale, Mapleton, and Elgin and Goshen near the western limit of the county. The results of the several analyses from the various localities are given under the proper heading of the district.

Throughout the several areas, it will be observed from the analyses that, the values in crude oil and ammonia gas, of the oil-shales from the different places, vary very considerably. The shales themselves vary much in character, ranging from a thin-bedded, brownish or blackish-grey, sometimes quite flexible and elastic,

often rich in fish remains, and usually known locally as 'paper shales,' to massive bands of black or brownish-black, tough shales, which occur as interstratified beds in the formation as a whole. While the greater part of these shales are bituminous, the black, massive beds, which range in thickness from 3 to 7 feet, are, on the whole, by analysis, much richer in ammonia gas and crude oil than the great mass of the thinner shales; though even in these, as far as tested, large portions are sufficiently rich in hydrocarbons to render them available for distillation.

In the western part of Albert county, toward Mapleton and Elgin, the shales, while preserving the general character of the Albert shales, have, on analysis, been found to be much poorer in hydrocarbons than those of the Albert Mines and Baltimore district. This is also true of the deposits found in Kings county.

It is interesting to learn from the work of the past season that, the ascertained values of many of the Canadian deposits greatly exceed what was at first supposed. It may be readily asserted that, in these deposits, considering the richness of much of the shales, their large extent—especially in the Province of New Brunswick—and their general accessibility and the facility with which they can be worked, Canada possesses a source of mineral wealth, the great value of which, if properly developed, can be scarcely overestimated.

In view of the great interest now being taken in the bituminous and oil-shales of the Albert series, both as regards the proposed extraction of oil by distillation, and systematic boring, the following synopsis dealing with the geological sequence of the strata of which the oil-bearing rocks are a part, may possess some points of interest.

The bituminous or oil-shales found in New Brunswick belong to what is known as the Perry formation, which unconformably underlies the marine limestone, associated gypsum, red marls, and the red, grey, or green conglomerates of the lower Carboniferous. In New Brunswick, the basal part of the Perry is represented by some hundreds of feet of reddish-brown, sometimes greyish-green, conglomerates, with which shaly beds, both red and green, are interstratified.

The lowest conglomerates of the Perry formation, as seen in the section on Kennebecasis island, are made up largely of fragments of Pre-Cambrian rocks, including crystalline limestone, granite, felsite, diabase, etc. At the base the pebbles are often from 12 to 18 eighteen inches in diameter. The conglomerates contain interstratified, irregular beds of red, sandy, and micaceous shale. Ascending in the series, the conglomerates gradually become finer, and are regularly interstratified with beds of grit and shale, the red and brown colour gradually gives place to grey, and the series becomes almost entirely a shaly one, the beds being grey and dark, sometimes black, shales interstratified with beds of a rather coarse, greyish grit. The darker shales have an abundance of plant and fish remains, corresponding, in this respect, with the shales of Albert and Westmorland counties. There is only a slight trace of bituminous matter in the shales of Kennebecasis island; but following them eastward they change in character and become bituminous, sometimes brown, pyroschists, containing sufficient hydrocarbons to render their ignition easy. Above these shales, and even forming a part of the shale series, are beds of greyish, sandy grit, containing oil, which can be obtained by boring in well selected spots, but, so far as yet known, in small quantities only. The bituminous shales, popularly designated as the Albert shales, do not yield oil in the free state as far as known.

In former years, in the selection of sites for boring, sufficient attention was not paid to the generally much disturbed character of the formation as a whole, the strata of which are often highly inclined, considerably faulted, and in places completely overturned, thus presenting features opposed to the formation of oil-reservoirs of any size. In recent operations—now being carried on in the Petitcodiac district by Mr. J. A. L. Henderson—this feature of the complicated structure is being taken into consideration, and the borings now being made have been located with due reference to the stratigraphical relations of the oil-sands proper. As a consequence, in the area

west of the Petitcodiac river and south of Stony creek, recent boring—though much delayed owing to loss of tools in the operations—has resulted in finding crude oil in fairly satisfactory quantity in at least one hole, and natural gas in at least two holes. Work in this area is now contemplated on a large and commercial scale, the present indications being quite favourable.

An interesting feature in connexion with the rocks of the Perry formation is seen in the elevation known as Indian and Lutz mountains, about 8 miles north of Moncton. In 1881, a short time was spent by one of my assistants—Mr. W. Broad—in making a survey of a part of the district, but the work was not finished. He recognized, however, the presence of a considerable mass or ridge of felsite which was supposed to be an extension of the Kingston formation and to be of Pre-Cambrian age. This was surrounded by a series of dark red conglomerates, at that time supposed to be of lower Carboniferous age, which in turn were overlaid by shales of various colours, among which were areas of brownish Albert shales, low in bituminous matter, but with the characters of Albert shales well developed. These conglomerates, on a recent examination, were recognized as a part of the Perry conglomerate, and they evidently underlie the mass of shales which make up the great bulk of these two mountains. As a rule, the associated shales are steeply inclined, and show the presence of faults and, possibly, overturns as the igneous mass is approached. They are succeeded elsewhere by a series of sandstones which may represent the oil-sands of the Petitcodiac River section; but in order to establish definitely the actual structure of this area a more detailed survey of the district will be necessary.

Albert Mines.

During 1909, several weeks were devoted to a further study of the shale areas of Albert and Westmorland counties, which had been tested—to some extent, during previous years. In the eastern part of Albert county, it was ascertained that greater value than previously given was to be attached to several areas, owing to the fact that analyses of the thin-bedded or 'paper shales,' with which the black oil-bands are associated, showed that this variety, to which previously little value was attached as a source of supply for crude oil, was nearly equal in its contents of crude oil and ammonia gas to the black oil-shales tested in the previous examination. These well banded, paper or thin shales form a very large proportion of the shale areas of the old Albert Mines property, and the importance of this discovery can be realized from the fact that these thin shales have a thickness of not much less than 1,000 feet, the greater part of which is well worth retorting. Much of this shale can be raised and sent to the retort very cheaply, since the greater part of the mining can be done by open-cut or steam-shovel methods; while in the old dumps derived from the mining of the original albertite vein, many thousands of tons of high grade shale are found, a great part of which can be put through the retorts without further treatment. As large quantities of albertite are also found in the mass of the dumps, the value of the whole is greatly increased, since, by analysis, the albertite carries over 100 gallons of crude oil, and more than 60 pounds of sulphate of ammonia to the ton.

During the past winter, analyses of several samples of thin or paper shales were made, which illustrate fairly well the character of the greater portion of the mass of the shale deposit along Frederick brook: the nature and extent of which can be inferred by comparison with the development work in connexion with the mining of the main albertite vein. Thus, in the Albert mine, in which the mass of shale passed through was largely of the thin-bedded variety, and in which the great vein of albertite occurs with a thickness, in places, of nearly 17 feet, the principal shaft, at the west end of the area, reaches a depth of 1,250 feet, and from it drifts are sent off on both sides. The thin shale is, as a whole, highly bituminous, and beds of the black shales were encountered at a number of places, as can be seen from the material in the dumps and from the records of the several levels. From the bottom of the main

shaft, a tunnel was driven north for 500 feet, all in shale of high grade, in which a well-defined anticline was cut through at a distance of about 400 feet from the bottom of the shaft. The workings at other levels showed material equally as good. On the whole, the bulk of the shale traversed by the several levels and exploratory pits is of very high grade as a material for distillation, and probably but little inferior to the black oil-bands on which the original estimate of value was based.

To the south of Frederick brook, which traverses the area of the Albert mines, a second tunnel, known as Robertson's tunnel, was, several years ago, driven south for 350 feet in a further search for albertite. This tunnel started from near the level of the brook, and was run toward the hill on which the manager's house is built. The tunnel traversed, for the whole of the distance, rich, thinly-bedded oil-shale; and this material can be seen to constitute the greater part of the hill, which lies in this direction. As to the character of the shale forming this hill, it may be said that it ignites readily under the flame of a match, thus showing that the contents in hydrocarbons are very high throughout. Similar shales in enormous amounts can be seen on the several branches of Frederick brook, both to the south and west, and also on those from the north. The shales are then covered over unconformably by the great mass of greenish conglomerate so conspicuous on the road to Salem, and along the upper part of Peck creek. Well-defined anticlines can be seen at several points in these shales. In the western part of the area, near the foot of Caledonia mountain, they are overlain by beds of greyish oil-sands, which when opened up some thirty years ago, gave off large quantities of gas. In one of the old tunnels driven in this sandstone, small quantities of oil were encountered.

Analyses made by the Mines Branch of samples from the five principal beds of black oil-shale, both curly and plain, uncovered last year along Frederick brook, are as follows:—

—	Crude Oil. — Imp. Gallons per Ton.	Sp. Gr. of Oil.	Sulp. Am. — Lbs. per Ton.
Bed No. 1. 6½ feet thick	48·5	0·892	82·8
" 2. 3½ "	38·8	0·892	69·3
" 3. 5 "	45·5	0·891	48 0
" 4. 4½ "	43·5	0·896	56·8
" 5. See below.			
" 6. 6 feet thick. (interbedded with thin paper shale)	27·0	0·895	49·1

Bed No. 5 consists of alternations of thin paper shales with hard thin bands, all apparently of excellent quality, and aggregating an unknown but very large thickness.

From samples of paper shale taken from Frederick brook near the north end of the large dump, at a well-defined anticline, were obtained the following results, with which are shown the results of analyses of oil-shale from Robertson's tunnel, and for comparison of a specimen of albertite:—

—	Crude Oil. — Imp. Gallons per Ton.	Sp. Gr. of Oil.	Sulp. Am. — Lbs. per Ton.
Frederick brook	40 8	0·892	41·0
" "	18·0	0·892	40·8
" "	33·5	0·890	47 0
Robertson's tunnel	32·5	0·885	33·0
Albertite	112·0	Undt.	65·4

Taylorville and Dover Areas.

The bituminous shales exposed at the Albert mines are concealed from thence easterly to the shore of Petitcodiac river at Hillsborough by red marls, green conglomerates, etc., of lower Carboniferous age, with which are associated large deposits of marine limestone, and gypsum. Across the river, the rocks of the Albert shale series appear at Beliveau, but are covered over within a short distance by grey sandstones of the Millstone Grit. The shales, however, emerge from this covering near the west bank of Memramcook river at Taylorville, where they form good exposures on the Taylor and Adams farms, which adjoin the road leading across the river to Upper Dorchester station on the Intercolonial railway. There, on the west bank of the river, a well exposed section of the oil-shales can be seen, showing several faults and overturns. Their presence is also recognized in the bed of the stream at low water near the Upper Dorchester bridge. On the east side of Memramcook river, the shales outcrop along the road leading from Memramcook village to Dorchester, and are again covered over in this direction by marine limestone and red marls. Northward, the shales outcrop in force near Memramcook, and on the west side of the river at St. Joseph's college and village, whence, with a covering of Millstone Grit and lower Carboniferous, they apparently extend in a northwesterly direction to Downing creek near Dover on the Petitcodiac. In this direction the shales form the north side of a syncline, the south side of which appears at Beliveau village.

Dover Shales.

The shales of Upper Dover ignite readily from the flame of a match, and should be valuable material for distillation. Samples from several points along Downing creek were collected by my assistant, and were mixed so as to give a fair average sample of the whole mass. The analysis of this mixed sample has been made by Mr. H. A. Leverin, of the Mines Branch, with the following result:—

—	Crude Oil. — Imp. Gallons per Ton.	Sp. Gr. of Oil.	Sulp. Am. — Lbs. per Ton.
Average of four samples from west bank Downing creek	27·2	0 921	29·5

Taylorville Shales.

A series of samples from the Taylorville shales was collected last year, and submitted for analysis to Dr. Baskerville of New York, since at that time the distillation plant of the Mines Branch had not been completed. These samples were taken from four beds of black oil-shale, both the plain and curly varieties. The thickness of these seams or beds as measured was, in two cases, 22 inches, while the third had a thickness of 36 inches, and the fourth, one of 60 inches. The results of the analyses of these samples, as made in Dr. Baskerville's laboratory and kindly furnished me, were as follows:—

—	Crude Oil. — Imp. Gallons per Ton.	Sp. Gr. of Oil.	Sulp. Am. — Lbs. per Ton.
Adams farm, Taylorville	43·0	0·900	93·0
Taylor " " No. 1	48·0	0·910	98·0
" " " No. 2	37·0	0·925	110·0

On the completion of the plant in the laboratory of the Mines Branch, Ottawa, a second series of samples was collected from these beds and analysed by Mr. Leverin, with the following results:—

—	Crude Oil. — Imp. Gallons per Ton.	Sp. Gr. of Oil.	Sulp. Am. — Lbs. per Ton.
Adams farm, No. 1	42·3	0·897	96·5
" No. 2	47·3	0 901	88·7
Taylor farm, No. 1	46·8	0·902	85·0
" No. 2	45·0	0·903	101·0

These black shale beds, like those of the Albert Mines, are interstratified with the thin, bituminous or paper shales. This location is about 1 mile west of Upper Dorchester railway station, and the same distance from a high water shipping pier on Memramcook river. The various bore-holes sunk in the area between the Petitcodiac and Memramcook rivers penetrated several beds of the oil-shales, and showed in several places the presence of interstratified beds of oil-sand with an appreciable quantity of crude oil at several points.

Baltimore Shales.

The results of the examinations of the shales of the Baltimore area, and the analyses of several of the black sands as furnished by Dr. Charles Baskerville of New York, were given in the summary of last year. Further examination confirmed the statements then made as to the wonderful richness of the black shale beds of the Baltimore area and of the grey shales of the West branch of Turtle creek, especially in crude oil, an analysis of one of the grey beds from this locality yielding no less than 56·8 imperial gallons of crude oil; while the yield of ammonium sulphate was 30·5 pounds per ton, the specific gravity of the oil being 0·891. Samples of these shales were subsequently taken from fresh openings and tested in the laboratory of the Mines Department, with the following result:—

—	Crude Oil. — Imp. Gallons per Ton.	Sp. Gr. of Oil.	Sulp. Am. — Lbs. per Ton.
Baizley	54·0	0·895	110·0
E. Stevens	49·0	0 892	67·0
Geo. Irving	40·0	0 895	77·0
West Branch (grey shale)	56·8	0 891	30·5

The Baizley bed has a thickness of 6½ feet: 4 feet curly, the rest plain.

A tunnel was driven into the Baizley area from the level of the brook north of Rosevale post-office for several hundred feet in a southeast direction. The material on the dump shows that the tunnel for the greater part of its distance passed through heavy bands of black oil-shale, both curly and plain, all apparently of high grade as regards crude oil and ammonia, the quality not differing greatly from that already tested.

Prosser Brook Shale.

A further test of the shale taken from Hayward brook, a branch of Prosser brook, some 4 miles west of Turtle creek, gave:—

—	Crude Oil. — Imp. Gallons per Ton.	Sp. Gr. of Oil.	Sulp. Am. — Lbs. per Ton.
....	30·0	0·895	75·0

Pleasant Vale Shale.

A further examination of the shale outcrops of Coverdale river near Pleasant Vale, and of those at Mapleton and at Elgin, was also made. In these deposits the percentage of hydrocarbons appears to be much less than in those already described and, as a whole, too low to be of much value for distillation purposes; although in physical features, their resemblance to the bituminous shales of the Albert series is easily recognized. At Pleasant Vale, the shale deposits were opened to some extent during the period when the Baltimore and Westmorland shales were exploited, nearly fifty years ago. A tunnel is reported to have been driven in the bank of shales on the east side of Coverdale river for some 140 feet, and a shaft was sunk on the west side of the stream to about 20 feet. It is also reported that the shales of this area were sufficiently rich in hydrocarbons to kindle readily with a match flame, and that small veins of albertite were found. A later examination of these shales was made, but they did not promise to be sufficiently rich in hydrocarbons to warrant a complete analysis being made.

Mapleton and Elgin Shales.

Westward through Mapleton the shale is exposed at a number of places following along the main road between this place and Elgin corner. Samples were collected south of Parkindale on the James Prosser farm, but here the shale appeared to be too sandy and lean to be of much economic importance. Several samples were, however, collected, and the analyses by Mr. Leverin showed the amount of crude oil to be only 4 imperial gallons per ton, with a specific gravity of 0·891. The shales of the area extending through Mapleton were not deemed sufficiently rich to warrant analysis; but at Bannister brook, where in 1876-7 much work was done by tunnelling and boring, samples were collected which gave, on analysis, 14 gallons crude oil per ton, with specific gravity, 0·893. This place is about 2 miles east of Elgin corner.

Goshen Shale (Montgomery Hollow).

The same lean character appears to affect the shales west of Elgin along Robertson brook; but on Montgomery brook near Goshen, which is 3 miles west of Elgin corner, beds of bituminous shale are exposed which appear to be much richer in hydrocarbons than those seen elsewhere in this area. Samples were selected, and on analysis by Mr. Leverin yielded:—

—	Crude Oil. — Imp. Gallons per Ton.	Sp. Gr. of Oil.	Sulp. Am. — Lbs. per Ton.
....	27·5	0·897	36·0

Sussex and Norton Shales (Kings County).

All the shales occurring south of Sussex and thence west to Norton, that were examined during the past season, appear to be so lean in hydrocarbons as to be valueless for distillation. Samples were frequently tested in the field, but none would kindle even with strong heat, though, in several cases, there was a slight smell of bituminous matter.

These lean shales are well exposed along the road running south for some miles up Wards creek, or almost to Wards mills; and, going west along the road to Campbells corner by way of Ratters corner, frequent outcrops are seen. Along the course of Moosehorn brook, which shows an interesting section of the rocks of this formation from the line of the railway to Campbells corner, the bituminous shale is not well defined; but the shales are again seen on a road leading southeast from Bloomfield station until they are terminated in this direction by great ledges of the red Perry conglomerate.

OIL-SHALES OF NOVA SCOTIA.

Prior to the work of the past season, much of the information possessed by the public relative to the oil-shales of Nova Scotia was obtained from the examination made by Mr. J. Campbell, whose results were contributed to the Mineralogy of Nova Scotia, published in 1868 by Dr. Henry How. As this publication did not give the exact distribution of the several oil-shale areas nor the analyses of the various deposits, it was deemed best to take up this aspect of the question and to ascertain, as far as possible, the actual value of these shales as regards their contents in crude oil and ammonia gas. The areas are indicated on maps by the late Mr. Hugh Fletcher, published by the Geological Survey. Large and representative samples of the various shales, many of which had not been previously examined, were collected, especially from the counties of Antigonish and Pictou.

Attention was first given to the deposits of shale found along the Avon river, at Hantsport and Horton, Cheverie, Walton, etc., all of these areas belonging to the same geological formation, and the sediments being of the same general character. The oil-shales of this area were mentioned in How's Mineralogy of Nova Scotia (1868), and were thought to also outcrop at the village of Newport, on the line of railway between Windsor and Halifax, a few miles east of the former place. In all the places named above, black shales are abundant, but are carbonaceous rather than bituminous.

Hantsport and Horton Shales.

In bore-holes for coal put down a few years ago near Hantsport, a depth of 1,500 feet was reached, and though no regular log is now available, it was ascertained from information obtained from one of the drillers who had charge of the work at that time, that the formation passed through for the first 600 feet was a greyish sandstone. This passed down into a black carbonaceous shale, and at 800 feet the drill was reported as cutting 10 to 12 feet of black oil-shale. Below this the drill is said to have passed through sandstone and non-bituminous greyish shale. The specimens obtained from the reported oil-shale band are said to have burned readily when exposed to a flame, but at the time of our visit, no specimens could be obtained for analysis, though large pieces of the core taken from the grey, sandy portion occur in the vicinity of the boring. Along the banks of several brooks, cliffs of grey and black shales were seen and carefully examined, but no beds of oil-shale of commercial value were found at any point in the vicinity. Ledges of a hard, white sandstone, almost a quartzite, occur, with black and grey shale holding numerous plant remains. Some parts of this shale are reported to burn readily, and are quite carbonaceous. None of the samples examined by us were, however, capable of being ignited in an ordinary flame.

The carbonaceous black shales, which occur along the beach between Hantsport and Horton bluff, are regarded as of the same geological horizon as the Albert shales of New Brunswick. They were carefully tested for several miles along their outcrop, and sampled by means of the usual field tests for bituminous shales, but without any promising result, the splinters of the shale not even igniting with a strong flame, though their flaggy, fossiliferous character is pronounced.

Cheverie and Walton Shales.

On the whole, it may be said that the sediments about Hantsport and thence north to Horton bluff resemble closely those extending eastward from the mouth of the Avon, between Cheverie and Noel, good sections being seen along this part of the shore east from the mouth of the river for some miles. The black shales and associated beds at Split rock and thence to Walton are often very black, but are carbonaceous rather than bituminous, though several thin bands are reported as being exposed at low water on the beach at Cheverie, and are said to ignite. Their exposed volume must be small, however, since along this part of the shore they are capped directly by masses of plaster and marine limestone of lower Carboniferous age, in which traces of crude petroleum are found. These reported oil-bearing shales were not visible during the time of our visit to this locality. They do not appear to possess much economic value.

Lochartville Shales.

In the vicinity of Lochartville, several miles northwest of Hantsport, oil-shales were also reported to occur. On examination, black, carbonaceous beds, with grey sandstone and grey and bluish shales, were found at several points. Several bands of these were said to ignite and burn readily, but in a close examination of this area no such rocks were observed. Several shafts and bore-holes have been sunk in these sediments, presumably for coal, but nothing of economic value has yet been discovered.

Newport Shales.

Two areas near Newport, east of Windsor, are supposed to be part of the shales described in How's Mineralogy, 1868; but a somewhat close examination of the district showed the shales there exposed to belong, in part, at least, to the black carbonaceous variety, and, in part, to be hard, altered shales with quartz-veins; nor could any of the residents of that locality who were interviewed, give any information as to where bituminous shales, such as had been described as occurring there, might be found. A small shaft was sunk some years ago in the black carbonaceous shale, apparently in a search for coal, as the place is still locally known as the 'coal mine,' but nothing of the nature of a true oil-bearing or bituminous shale was observed.

While, therefore, from the testimony of several residents of this part of the Province, it would seem that certain bands of bituminous shale exist in the shale formation of the area about the mouth of Avon river, thus confirming to some extent the statement of Mr. Campbell in How's Mineralogy, it must be said that in our examinations of the past season no person could be found who could indicate where bands of oil-shale could be located.

Shales East of Parrsboro.

Crossing Minas basin to Parrsboro and going east to Moose and Harrington rivers, large ledges of black and grey shales were observed on these streams, on several other brooks, and also along the roads from Parrsboro to Five Islands. At the crossing of Moose river there are cliffs of greyish and black shale, some portions of

which are quite black and carbonaceous. All are highly inclined, often much folded, and without much indication of bituminous matter. On the whole, they are like the rocks of the lower Avon just described. As a rule, greyer beds predominate over the black and hold interstratified beds of hard sandstone, sometimes quite quartzose, and like those in the vicinity of Hantsport. The rocks are generally steeply inclined, sometimes at angles of 75° to 90°. They are often splintery or pencil-shaped, a structure induced evidently by pressure. The series as a whole, in so far as examined at a number of widely separated points, is but slightly bituminous. Similar shales outcrop in the vicinity of Parrsboro village, but no bituminous shales of the aspect or type of the Albert shales were seen at any point in the area.

Shales of Truro and Onslow.

An examination of the shale deposits near Truro and vicinity, as seen along the North river in Onslow and the streams flowing from the south side of the Cobequid range, shows them to be very similar to those of the Avon river just described. The shales are generally hard and dry looking, varying in colour from grey to reddish-brown and black, with hard, sometimes quartzose, greyish sandstone. So far as examined, the series appears to be largely non-bituminous, the black portions being of the carbonaceous variety, like those already described elsewhere. No trace of oil-shale was observed in this series, which extends along the south side of the Cobequid mountains for some miles. In places, as on Debert river and at Cottam settlement, small seams of coal are found, generally too thin, impure, and dirty to be of much economic importance. They resemble in some respects the seams found at Hallowell Grant in Antigonish county, the rocks of both places being apparently of the same geological horizon. In all places where the rocks of this formation are found, they are unconformably overlaid by the limestones of the lower Carboniferous. The black carbonaceous shales of the North River district occur in large cliffs along the stream, and it was hoped that a careful examination of this area would have shown some indication of the bituminous or oil-bearing series of New Brunswick, to which horizon they seem to belong. So far our expectations in this direction have not been realized.

Shales of Pictou and Antigonish Counties.

Farther east, in the counties of Pictou and Antigonish, both carbonaceous and bituminous shales occur in large quantity. The formation in Pictou was very fully described by Sir William Logan and Mr. E. Hartley, in the Geological Survey Report published in 1869, a book long out of print. During the past season, the principal outcrops there mentioned were carefully investigated, and large samples were collected for analyses by the Mines Branch in order that their contents in crude oil and ammonia gas might be ascertained.

Shales of McLellan Brook, Pictou County.

The principal development of the shales in Pictou county is along McLellan brook, south of New Glasgow. This stream is a branch of the East river of Pictou, along which, in this area, the shales are also exposed in a series of cliffs often of large extent; they also appear on several other branches, notably on Shale and Marsh brooks. The greater part of the shales are of the black or carbonaceous variety rather than the bituminous, but large quantities contain sufficient hydrocarbons to ignite readily in the flame of a forge, in which a number of them were tested in the field examination. At a point on McLellan brook known as the old Fulling mill, the shales are associated with oil-shales which closely resemble the stellarite found in the Acadia Coal Company's areas at Stellarton, described by Sir William E. Logan in the Report for 1869.

Eight samples, to make a good average test of the shales of this area, were collected from points along the main stream and from other outcrops adjacent. The results of the analyses of these, made by Mr. Leverin, are given below. Sample No. 1, taken on McLellan brook, is from Patrick's slope, a short distance below the old Fulling mill; the area is affected by faults; the width of the bed, in places, is as much as 8 feet, but, in the old workings, in places, is a few inches only:—

—	Crude Oil. — Imp. Gallons per Ton.	Sp. Gr. of Oil.	Sulp. Am. — Lbs. per Ton.
No. 1. McLellan brook	42·0	0·889	41
No. 2. " " (near Black's old mill site)	14·5	0·892	35
No. 3. Marsh brook, tributary from the east, lower end	8·0	Undt.	Undt.
No. 4. 150 feet above McKay's house	3·0	Undt	Undt.
No. 5. Marsh brook, 300 feet above McKay's house	14·0	0·903	Undt.
No. 6. Shale brook, tributary from west, near forks with main brook	9·0	0·921	Undt.
No. 7. Shale brook near upper end of brook	4·0	Undt.	Undt.
No. 8. One mile west of Woodburn station, on small brook, and 500 feet north of railway track, bed of shale 10 feet thick	14·3	0·902	Undt.
No. 9. Stellarton, stellarite from old dump	44 8	0·875	14·5

The original description of stellarite, given in Logan's and Hartley's report, 1869, shows the amount of crude oil to vary greatly at different points in the shale bed, ranging from 45 to 130 gallons per ton; apparently no tests for sulphate of ammonia were made at that time.

Antigonish Shales.

In Antigonish county an examination was made of the shale and coal deposits found at Big Marsh or Hallowell Grant, about 9 miles north of the town of Antigonish. This was one of the areas described by Mr. Campbell in How's Mineralogy of Nova Scotia, 1868. Both the plain and curly shales were found in considerable quantity, and eight samples were collected from various points in the field. These have been thoroughly tested in the laboratory of the Mines Branch by Mr. Leverin.

The Big Marsh (Dan McDonald's) location is situated near the corner of the road beyond the post-office, about 9 miles from Antigonish station on the Intercolonial railway. The deposit was opened about 45 years ago by a shaft, sunk to a reported depth of 60 feet, of which the upper 40 feet is said to be in a plain, black carbonaceous shale. The lower 20 feet of the shaft is said to be in a black, curly shale, portions of which ignited quite readily. Samples of both varieties were collected. On testing in the field, the black, plain, carbonaceous variety kindled with difficulty in a stove with a strong draft. The curly variety on examination proved to be for the most part a carbonaceous shale containing only a small amount of crude oil, the analysis in the laboratory giving only 4·8 gallons, and of sulphate of ammonia, 8·7 pounds, per ton. This part of the deposit, therefore, has but small economic value.

On the road east to the shore of George bay, black shales are well exposed at a number of points. These were all examined. On both sides of the post-road near Big Marsh post-office, outcrops of black carbonaceous shale occur, with other beds which are greyer, siliceous, and micaceous. Near the post-office there is a seam of dirty coal from 5 to 8 feet thick, which has been opened to a small extent. Samples of this analysed in the laboratory show the percentage of ash to be so large as to render the

coal practically unfit for fuel, the amount of ash being 45 per cent. The associated shales are apparently devoid of hydrocarbons, the black portions not igniting even under a strong flame.

Other outcrops of the black carbonaceous shales of this formation are seen for several miles along the road toward Antigonish; but these, while very black, would not ignite even under the flame of a blow-pipe. They contain plant stems and fish scales, the fossil *Lepidodendron corrugatum* being fairly conspicuous. They resemble the shales found farther west, at Avon river and near Truro. No analyses were made of the shales associated with the coal seams of this place, since their general character was so unfavourable.

Going east from the corner near Big Marsh post-office, a small stream known as McLellan brook crosses the road and shows ledges of black shale, both the curly and plain varieties. Samples of these were taken, which were analysed by Mr. Leverin, the results being, for the curly portion, 6 gallons of crude oil per ton, while the plain shale gave neither crude oil nor sulphate of ammonia. On Sawmill brook, a short distance east of John Boyd's house, large outcrops of very black and greyish shales, both of the plain and curly varieties, are found, forming cliff-like banks with an elevation of 100 feet or more. These were tested at a number of points, and gave the most favourable returns of any of the shale deposits found in this area. At a place known locally as the 'Banks,' from which the timber has been largely burned, the shale, of which the banks are composed, was ignited several years ago, kindled probably by a bush fire, and continued to burn for many months. The shale thus exposed appears to be comparatively rich in hydrocarbons, and shows a very large development along this part of the stream. An analysis of the shale from this area is given below:—

—	Crude Oil. — Imp. Gallons per Ton.	Sp. Gr. of Oil.	Sulp. Am. — Lbs. per Ton.
The "Banks"	11·0	0·917	22·6
Sawmill brook—curly shale	10·0	0·893	38·0
Sawmill brook—plain shale	23·6	0·906	34·0
	10·0	0·890	17·0

It would appear from the results of these analyses, that portions of the immense quantities of shale exposed at this place might be profitably mined, since the returns both from the plain and curly varieties are good both in crude oil and ammonia. The fact that these samples were taken from near the surface, and may have been affected by the burning which devastated the area, leads to the belief that, possibly, samples taken from deeper excavations might give, on analysis, better results.

Farther east, at what is known as the Beaver, near the shore road, considerable areas of very black, carbonaceous shales occur. These, some years ago, had been opened by small pits at several points; among other places, on the land of Mr. Hugh McInnis. The shales at this place are jet black, and contain in some layers an abundance of plant stems and fish scales. The yield of these shales in the laboratory gave of crude oil, 7·45 gallons per ton; the amount of sulphate of ammonia was not determined. The horizon of these shales seems to be the same throughout the area.

Cape Breton Island.

The rocks about Hastings on the east side of the Strait of Canso, and thence north for some miles, are apparently of the same series as those of Antigonish just described, and, like them, are unconformably overlain by lower Carboniferous limestone and gypsum. No shales of a bituminous nature were anywhere observed, though such shales may exist at some points inland, concealed by overlying formations. The only deposits in Cape Breton, so far known, are those of McAdam lake, which were described in last year's Summary Report. They are not, as far as they have been tested, oil-bearing to any marked extent.

OIL-SHALES OF GASPÉ, QUE.

In August, accompanied by my assistant—Mr. S. C. Ells—a visit was made to Gaspé basin, to examine the reported occurrences of oil-shales in that part of Quebec. In this work traverses were made along several of the rivers for considerable distances, the area cursorily examined being not far from 300 square miles, or 30 miles in length by 10 miles in width. The reported oil-shales, which are rather of the nature of a resinous, shaly sandstone, occur in the vicinity of the village of Gaspé and along the York and St. John rivers, which flow into Gaspé basin. These oil-bearing rocks were referred to in the report by Sir W. E. Logan on this country, 1843-4. The presence of several oil springs in this area was also pointed out by Logan, and subsequently many thousands of dollars were expended in boring operations for oil. The companies principally engaged in this work were: the Petroleum Oil Trust of London, England; the Canadian Petroleum Company of Manchester, England; and the International Oil Company of Minneapolis, U.S.A. In all, more than fifty wells were sunk in the Gaspé area, several of which reached a depth of over 3,500 feet. A description of the geological structure of this district, with an account of the various borings and an unabridged record of most of the logs, was given in the Summary Report for 1902.

The so-called oil-shales are quite distinct in character from those of New Brunswick and Nova Scotia already described. They belong to the upper Devonian, and are of the nature of greyish sandstones, which are shaly in places. These rocks contain layers of plant remains, among which *Psilophyton princeps* is particularly abundant, and certain beds of the shaly rock are almost made up of the remains of this fossil.

The possibility of the future economic value of these shaly rocks about Gaspé was alluded to by Sir W. E. Logan in his early report above noted. It was found that the oils obtained by boring were of two kinds, viz., a light-amber coloured oil which was obtained chiefly from the upper or sandy portion of the formation, and a dark-green, heavier oil which was obtained from the calcareous, underlying rock, which apparently was more closely allied to the upper Silurian. The upper or sandstone series, represents what is known as the upper portion of the Gaspé Devonian. The layers which show the plant remains most abundantly are greyish-black in colour, kindle readily when a lighted match is applied, and burn with a strong, yellow flame. These beds are heavily charged with a black or sometimes yellowish resin, which appears to represent the gummy portion of the plants. The residue after ignition is almost a pure, greyish, quartz sand.

Large samples of these sandy oil-shales were collected at a number of points, and have been analysed at the Mines Branch by Mr. Leverin. Three samples were chosen for analysis, of which two were from York river and one from the St. John near Law brook. The results of the analyses are as follows:—

—	Crude Oil. — Imp. Gallons per Ton.	Sp. Gr. of Oil.	Sulp. Am. — Lbs. per Ton.
St. John river, on Law brook :—			
No. 1. from band 14 inches wide	30·0	0·962	42·20
No. 2. " 5 inches " Oil tarry	31·5	0·977	40·00
No. 3. from loose piece on York river, pieces large and numerous	36·0	0·953	59·50

The principal places where the oil-shales occur in Gaspé, as observed during the past season, are mentioned in the following descriptions. At the site of Shaw's old mill (now demolished) in the west part of the village of Gaspé Basin, where ledges of grey sandstone with associated grey shales outcrop, portions of the sandstone are shaly and contain an abundance of plant stems, apparently for the most part of *Psilophyton*. The outcrops near the mill site are now largely obscured by debris, so that the beds rich in hydrocarbons are concealed. The thickness of the oil-bearing sediments at this place, as seen and described by Logan, was from 12 to 15 inches, and the outcrop was traced for a distance of about 200 feet, until covered by the overlying sandstone.

Referring to the presence of bituminous matter in these rocks of Gaspé, Logan remarks[1]: 'Some beds of these rocks contain, besides, a peculiar resinous matter, which forms the cementing material. It appears on the fractured edges of the beds, in the form of irregular laminæ rarely an eighth of an inch in thickness, and generally much less. It has a vitreous lustre, a conchoidal fracture, and is tough, with a hardness nearly equal to calc-spar. Its colour is deep reddish-brown, but it gives a fawn-coloured powder, and when in thin plates or fragments is translucent, and has an orange-red colour. The substance has neither taste nor odour; it is insoluble in alcohol, naphtha, or potash lye, and is but slightly attacked by nitric acid. It is scarcely fusible; but at a high temperature is decomposed, with a slight softening and swelling up, giving off abundance of inflammable vapours, and leaving a small quantity of brilliant spongy coke. It has the appearance of fossil resin, something like amber, but in its general characteristics approaches more nearly to what have been named schleretinite and middletonite.

'The portions of the sandstone impregnated with the resin burn when kindled, with a brilliant flame and much smoke, and the residue which consists chiefly of siliceous sand has very little coherence. Partial analyses were made of four fragments of this rock which were supposed together to represent an average of the mass. The amount of volatile matter, of fixed carbon or coke, and of the incombustible residue was as follows:—

—	I.	II.	III.	IV.
Vol. matter	32·4	22·8	42·8	30·4
Carbon	8·9	8·1	7·4	8·9
Residue	58·7	69·1	49·8	60·7
	100·00	100·00	100·00	100·00

[1] Geol. Canada, 1863, p. 791.

'The purest specimen is seen to yield the smallest amount of fixed carbon. The excess of this in others is due, in part, to the small portions of mineral charcoal generally present among the layers of this resinous sandstone. The material could be made to furnish large quantities of illuminating gas and lubricating oils, by a process of distillation similar to that applied to coal and bituminous shales. In some experiments made on a small scale to test its powers of producing illuminating gas, it was found that a few pounds of this material, which lost by distillation 26 per cent of its weight, yielded 2¼ cubic feet of gas of superior illuminating power, to the pound. As this quantity of volatile matter corresponds to about 33 per cent of resin, it is evident that if obtained in a state of greater purity this material would become valuable as a substitute for coal in gas-making.'

The specimens from which the preceding analyses were obtained were taken from the bed in the vicinity of Shaw's mill already referred to. An examination of the shore of the York river was made for some miles up-stream, and although the sandstones of the formation could be traced at intervals, for a long distance, the presence of the resinous sandstone portion was not seen in place along the lower part of the stream, though large, loose pieces, evidently from a bed of this substance in the near vicinity, were found along the beach and in several small streams flowing from the hills to the north and cutting across the measures. About 3 miles above Shaw's mills, the blocks of this resinous shale were large and numerous along the beach, also in the bed of a small brook; but owing to the large covering of drift the position of the bed from which these pieces were derived could not be determined.

By means of a canoe, a traverse was made by my assistant up the York river for nearly 30 miles, in which distance bands of the resin-bearing shaly sandstone were seen at a number of places. Owing to the prevailing rainy weather during this trip, the examination of the several beds was necessarily curtailed to some extent, but the bands were found to be from 4 to 12 inches in thickness, extending in lenses, sometimes for 100 feet. Of these bands Sir W. E. Logan says:[1] 'Some of them are composed in great part of laminæ of a brilliant brownish-black matter; which when examined in thin fragments show the same reddish translucency as the resin just described, and are apparently similar to it in composition; although in some cases mingled with more coaly matter and containing less ash. A specimen from one of these beds on the York gave of volatile matter, 52·4 per cent; carbon, 26·3 per cent; residue, 21·3; total, 100·00. The greater portion of volatile hydrocarbons which may be obtained from this would render it still more valuable for distillation than the bed whose analysis has been given above. These curious deposits are evidently worthy of future study from an economic point of view.'

A brief report on the results of this recent trip of my assistant up the Gaspé rivers is here given, and confirms, to a large extent, the views stated in the Geology of Canada, 1863, already quoted.

With the exception of the statements already quoted, practically nothing definite was known as to the occurrence of oil-shales anywhere in the Gaspé peninsula. The results here given are of a six days' trip up the York river, along the lower part of the St. John, and of the stream flowing into Seal cove, farther south. The several samples collected may be considered as representing the best quality of the oil-bearing bands found in the eastern Gaspé district, though several outcrops of inferior quality were also noted.

Owing to the rapid rise in the streams, due to numerous rapids and small waterfalls, the thickness of the shales in which hydrocarbons might be looked for, could not be definitely ascertained, but it embraced several hundreds of feet. Several streams, including the Dartmouth, York, St. John, and Seal cove, all flowing into Gaspé basin, were traversed, the distance varying according to the development of the underlying

[1] Geology of Canada, 1863, p. 792.

Silurian formations. Thus, on the south side of the Lower Dartmouth, which flows into the north arm of Gaspé basin, grey sandstone and shales appear in almost continuous ledges westerly from the village of Gaspé Basin, the dip for this portion being northerly, and the axis of an anticlinal at the village following along the north side of York river. Along the south side of the Dartmouth, approaching Calhoun's mills, the grey sandstones pass up into reddish beds; while on the north shore, the ledges have a southwesterly dip, showing the presence of a synclinal along this part of the stream. The rocks along the north shore seem to represent, in part, the portion of the formation which passes from the Devonian into the upper part of the Silurian. Westward on this stream, igneous rocks, including serpentine as at Ladysteps brook, appear, and the underlying Silurian occupies the valley from a short distance above the falls of the Dartmouth. No trace of the oil-shales was seen on this lower part of the river.

The York river was ascended to a point a short distance above Falls brook, or about 30 miles above the mouth at Gaspé village. The St. John river, which is the next to the south, was ascended to a point about 3 miles west of Law brook, or well into the area occupied by the Silurian, and the Sealcove river to a distance of about 6 miles from its mouth. On this last stream, owing to the generally low and swampy nature of the banks, rock outcrops were rarely seen, so that in this direction nothing as to the economic value of the shales could be ascertained. Several tributary streams were also traversed, in all of which indications of the resin-bearing shales were observed either as drift or in place. The area of country from which samples, considered to be typical of the oil-bearing strata, were collected, is about 150 square miles.

In all, some twenty-three small seams were found, ranging in thickness from 1 inch to 5 inches. A more extended examination of the district would, probably, show double the number. These thin beds sometimes unite to form zones. Thus, on St. John river near Flat Rock, zones of 5 to 8 feet carry numerous thin bands of the resin-bearing shale separated by sandy partings. Of these small bands, the heaviest appear to be about 13 inches in thickness. None of the outcrops seen at this place or elsewhere would seem to warrant much expenditure in development work; but if analyses indicated high contents in hydrocarbons, then further detailed examinations, either on the surface or by the aid of a light drill, would seem to be advisable.

The sandstones along the lower York and St. John rivers show the presence of three main anticlines, the strata, for the most part, being inclined at angles of less than 30°; but in places the angle of dip is much higher. Through these sandstones, fossil plants are generally widely distributed, and accumulations of these organic remains appear to have given rise to the bituminous matter and the contained hydrocarbons. Unlike the oil-shales of New Brunswick, in which the oil appears to be a chemically combined constituent of the shales, the oil in the Gaspé shaly sandstone occurs often in the form of hardened patches of bitumen, sometimes in appearance resembling albertite, and distributed in greater or less amount as a physically combined constituent of the sandstone. It was also noted that in the more massive beds of the sandstone, the layers are of larger size and of apparently richer quality than in the thinly laminated sandstone.

Regarding the oil-shale or resin-bearing bands, irregularity both in thickness and in longitudinal extent constitutes a very serious feature. In fully 50 per cent of the outcrops seen, they pinch out within a distance of 150 feet, forming lenses rather than uniform beds or seams. In other cases, the beds split up into very fine narrow bands of an inch or even less in thickness within a distance of not more than 200 feet, thus showing the rapidity with which such changes may be expected. It is difficult to say whether conditions favourable to the formation of heavy seams would be also more favourable to greater uniformity as to thickness and quality..

From the evidence obtained in this brief reconnaissance, the conclusions so far arrived at relative to the occurrence of deposits of oil-shale of commercial value in the Gaspé basin cannot be regarded as favourable, though careful prospecting of detailed character may lead to the discovery of seams of oil-bearing rock of more promising dimensions.

In the event of such prospecting being attempted, the following suggestions may here be given. The rivers are easily navigable by poling in canoes, and on these streams and on some of the small branches, practically all the rock exposures of the region may be found. In many cases, cliffs, 25 to 125 feet in height, either skirt the shores or are found at a distance of a few yards back from the shore-line. Considering the many low-lying ledges, the season of low water, including the months of July and August, will obviously be the most favourable period for prospecting. The oil-bearing bands are difficult to distinguish from the bed-rock proper at a distance of more than a few feet, thus making a traverse on foot of each shore practically a necessity.

BATHURST DISTRICT, NEW BRUNSWICK.

(G. A. Young.)

INTRODUCTION.

The field season of 1909 was spent in the neighbourhood of Bathurst, N.B., with the object of extending southward the mapping of an area commenced in 1908. During the first season there was mapped a strip of country running south from Chaleur bay along the west shore of Nipisiguit bay, measuring about 18 miles long, with an average width of 8 miles. During the past season, 1909, a contiguous area of about 150 square miles, lying immediately south, and including the town of Bathurst at the mouth of Nipisiguit river, was topographically and geologically surveyed. An additional area of about 1 square mile, situated south of the limits of the map-sheet and surrounding the Nipisiguit iron deposit, was surveyed in detail.

The Bathurst district is important because of development work in progress in connexion with deposits of iron ore lying some 15 miles inland, to the south of Bathurst. It was hoped to extend the map-work sufficiently far south to embrace the area in the immediate neighbourhood of the ore bodies; but the comparatively slight vertical relief, and the heavily wooded character of the wholly unsettled country in the southern part, made progress so slow as to prohibit the accomplishment of this aim. Instead, the general map-sheet work was continued inland to latitude 47° 30′, or about as far south as Pabineau falls on Nipisiguit river; and a small detached area immediately surrounding the iron deposits was mapped in detail.

The examination of the geology of the district was carried out by the writer; while the work in connexion with the topographical surveying was entrusted to a number of student assistants, all of whom performed their duties in a painstaking and highly satisfactory manner. Mr. W. E. Lawson—assisted by W. L. Uglow, H. W. Fleming, N. C. Macrae, and A. G. McIntyre—was placed in charge of the transit-chain control work. Mr. D. A. Nichols—assisted by A. Boucher—took charge of the plane-table-stadia traverses of roads and streams. Mr. B. Rose—assisted by J. L. Cavanagh—sketched in contours with 50 ft. intervals, by meandering traverses run by plane-table, compass, tape, and aneroid. All plane-table work was done on a scale of $\frac{1}{8000}$.

The district mapped during 1909 lies at the junction of the regions shown on two geological maps prepared by R. W. Ells and published by the Geological Survey.[1] The results of a magnetometric survey of the Nipisiguit iron field have been issued by the Mines Branch.[2] A description of the iron deposits has been given by Mr. J. E. Hardman.[3] References to the geology of the district occur in some of the older reports of the Geological Survey; in publications of the provincial government; in 'Acadian Geology,' etc., etc.

GENERAL CHARACTER OF DISTRICT.

The district lies along the northeastern edge of the rugged country of central and northwestern New Brunswick where this relatively elevated region is bordered by the comparatively low, almost flat, Carboniferous area of the eastern part of the

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1 Sheet 3 S.E., Bathurst Sheet, Scale 4 miles to 1 inch, and Sheet 2 N.E., Newcastle Sheet, Scale 4 miles to 1 inch; accompanying reports, Part D and Part DD, Ann. Rept. Geol. Surv. Canada, 1880-1-2.

2 Magnetic Survey, Austin Brook, Gloucester Co., N.B., by E. Lindeman.

3 Hardman, J. E., 'A new iron ore field in the Province of New Brunswick,' Jour. Can. Min. Inst., Vol. XI., 1908, pp. 156-164.

Province. Within the limits of the sheet, the north-flowing Nipisiguit river approximately marks the boundary between these two contrasting types of country. On the east, the nearly level, slightly rolling country, underlain by practically horizontal Carboniferous strata, gradually rises from the sea to a height of about 270 feet. West of Nipisiguit river, over the area occupied by highly folded and faulted pre-Carboniferous strata and invading igneous bodies, the land rises more rapidly to a maximum height of slightly over 700 feet above the sea.

West of the Nipisiguit, the contours pursue generally, north and south courses, but swing far up the often gorge-like valleys of the easterly-flowing streams and rivers tributary to the Nipisiguit. In a number of instances these ravine-like waterways are particularly striking, as in the case of that of the Tetagauche river, the waters of which are confined to a narrow, trench-like depression seldom more than 200 feet wide, with steep, often almost vertical walls rising 75 feet to 200 feet above the river bed. But, except in the immediate neighbourhood of the larger waterways, the country is broadly rolling, with only an occasional outstanding hill. Save for the stream valleys, the surface of the country is a tilted plain rising from the Nipisiguit valley, with a fairly even westerly gradient.

GENERAL GEOLOGY.

The two contrasting types of country east and west of the Nipisiguit are, geologically also, sharply differentiated. East of the Nipisiguit the country is underlain by almost undisturbed, reddish, fine conglomerates, sandstones, and shales of Carboniferous (Millstone Grit?) age. West of the river, the rocks are largely early Palæozoic (Ordovician?) sediments, chiefly black slates and grey sandstones and slates, closely folded and faulted, and in places, schistose. They are penetrated by dike-like bodies of igneous rocks, and to the south and west of Bathurst by a large body of granite that disappears eastward beneath the younger Carboniferous strata.

The country, as a whole, is very unfavourable to the study of geology. Save along the beds of a few of the larger streams, exposures are usually wanting. Over square miles of country, no rock *in situ* appears, the underlying formations being largely hidden by morainic and other material of glacial origin. Because of this general lack of exposures and the highly folded attitudes of the beds west of the Nipisiguit, it is not possible to offer an entirely satisfactory classification of the sedimentary rocks or to determine with certainty their ages. The following tabular list of formations is, therefore, but an imperfect one:—

QUATERNARY.

Stratified clay, sand, and gravel.
Glacial till, morainic deposits, etc.

PALÆOZOIC.

Carboniferous—
Bathurst formation.

Devonian?—
Bonaventure formation.
Nipisiguit granite.

Post-Ordovician—
Basic dikes.
Austin Brook quartz porphyry.

Ordovician—
Black shales, sandstones, etc.

Ordovician, Black Shales, Sandstones, etc.—Along nearly the whole course of the Tetagauche river, and at intervals in the beds of Little and Middle rivers, are numerous exposures of tilted and faulted, black, often highly graphitic slates, in many places accompanied by broken or torn bands of fine, dark sandstone. With the dark beds, also occur one or more zones of brick red, hardened, argillaceous or fine, arenaceous, slaty beds. Though rarely seen in the intervals between the main streams, these dark slates, etc., doubtless occupy nearly the whole of the country east of the Nipisiguit, excepting the portion underlain by the batholithic area of Nipisiguit granite. To the south, beyond the limits of the map-sheet and south of the granite body, the dark slates and associated beds reappear along the Nipisiguit, and are there intruded by the Austin Brook quartz porphyry, with which are associated the Nipisiguit iron deposits.

In places, the slates are schistose, apparently both along zones of shearing, etc., and in the neighbourhood of the granite batholith. The strata are closely folded, the strike, in general, being east and west, and the dip often nearly vertical. Quartz veins are common, and are very numerous in narrow zones. At many places, the rocks are impregnated with pyrite, often to a high degree.

Fossils were found in these beds at only one locality, on the Tetagauche, near the crossing of the Intercolonial railway, where imperfectly preserved graptolites occur. A collection of these graptolites made by an earlier observer, was examined by H. M. Ami, who stated that the enclosing shales 'appear to be . . . . homotaxial with the shales of Norman Kiln, near Albany, N.Y. . . . . ;[1] that is, with the lower Trenton.

On the several rivers already enumerated, appear comparatively narrow zones of fine tufaceous conglomerates, sandstones, and shales, all grey in colour, and closely enfolded with the dark slates. It is possible that these grey measures lie along synclinal axes of folding, since they closely resemble grey beds more widely exposed to the north, in the district examined in 1908, where they appear to underlie fossiliferous Silurian measures.

Post-Ordovician, Austin Brook Quartz Porphyry.—The Ordovician slates, sandstones, etc., occur for a number of miles along the shores of Nipisiguit river, south of the southern boundary of the granite batholith. About half a mile below the Great falls of the Nipisiguit, at a point some 7 miles south of the boundary of the area of the main map-sheet, the sediments are followed by quartz-porphyry and associated rocks, that extend along the river for over a mile to the mouth of Austin brook and for an unknown distance beyond. The area of quartz porphyry is important, since within it occurs the iron deposits.

Normally, the quartz porphyry is a dark rock full of transparent, glassy grains of quartz often small in size, and usually accompanied by white crystals of feldspar lying in a dense matrix. At times the phenocrysts are large, and in some cases, those of feldspar are fully half an inch in length. Almost invariably, the rock has a schistose parting, and in certain zones or areas it has been changed to chloritic and sericitic schists.

The contact of the quartz porphyry and the sedimentary series was seen at one locality, where it appeared conformable to the bedding planes of the clastics. The quartz porphyry appeared to be intrusive, and, possibly, the intrusion took the form of an immense sill. The porphyry seems to have been involved in the main folding of the region, and in age, therefore, is probably pre-Devonian.

Post-Ordovician, Basic Dikes.—North of Tetagauche river, and to a less extent to the south, are exposures of dark, basic rocks called diabase in the field. They

[1] H. M. Ami, Summary Report for 1904, Geol. Surv., Canada, pp. 289-290.

apparently belong to a series of dikes some of which appear to be of considerable magnitude. Somewhat similar forms cut the Austin Brook quartz porphyry, but were nowhere observed cutting the Nipisiguit granite.

Devonian, Nipisiguit Granite.—Exposures of granite occur on the lower reaches of Little and Middle rivers and on Nipisiguit river from above Rough Waters to a point about 5 miles above Pabineau falls, or over a distance, in all, of about 8 miles. Though scarcely a single exposure of granite was found in the areas between the waterways, it is fairly evident that all the observed exposures belong to the western part of a single batholith whose major axis runs north and south with a length of about 11 miles. The eastern part of the granite body is covered by the younger, overlying Carboniferous sediments lying east of the Nipisiguit.

Typically, the granite is a grey, biotite granite, with a slightly pinkish tinge, due to the presence of numerous, large crystals of feldspar. The larger feldspars lie in a fine, grey matrix of feldspar, quartz, and abundant biotite. Other varieties of granite are less abundantly present. Pink aplite dikes are common.

The granite undoubtedly penetrates the Ordovician slates and associated sediments, sending dikes into them and altering them in the neighbourhood of the contact. Along the course of the Nipisiguit, numerous exposures show the granite passing under the red, Carboniferous beds of the Bathurst formation, of which the lowest beds—for a few inches or more—are usually of the nature of a fine arkose, composed of material derived from the breaking down, apparently *in situ*, of the granite. At a number of points the contour of the plane of contact between granite and sediment is visible, and where this is so the old rotted surface of the granite may be seen to have rounded, mammillary outlines, while the rock itself presents parting planes concentric with the outline of its surface.

The Bathurst granite appears to have been intruded at a period intermediate between the folding that, farther north, involved Silurian measures, and the deposition of the beds of the Bonaventure formation of late Devonian or early Carboniferous age. Therefore, the granite is regarded as being of Devonian age.

Devonian, Bonaventure Formation.—Within the area covered in 1909, only one exposure of the Bonaventure formation was seen. In the previous year, the formation was met with at intervals along the sea coast. The beds are usually dark red in colour, flecked with white from carbonate: they consist of coarse conglomerates, coarse and fine sandstones, shales, and less often, dolomitic beds.

These beds, as exposed along the shores of Nipisiguit bay and westward along Chaleur bay, have been correlated by a number of observers with the Bonaventure beds as exposed on the island of that name lying off the extremity of Gaspé peninsula, Quebec. The Bonaventure formation has usually been classed with the early Carboniferous, but in recent years doubt has been expressed as to the propriety of so doing, and the opinion advanced that they should rather be regarded as of Devonian age.[1] In the previous Summary Report of 1908, the Bonaventure beds were assigned to the Carboniferous, on the supposition previously expressed, or implied by various geologists, that these beds conformably underlaid the Millstone Grit east of Nipisiguit river. This year's examination of the area, however, failed to confirm the supposed equivalency of the beds underlying the Millstone Grit and those of the Bonaventure formation lying along the coast, and, therefore, following Clarke, they are now considered to be late Devonian rather than early Carboniferous.

Carboniferous, Bathurst Formation.—The beds of the Bathurst formation are red coloured, fine conglomerates, sandstones, and shales, and are exposed at intervals along the banks of Nipisiguit river almost from its mouth to a point several miles above Pabineau falls. Sandstones and shales are the common varieties; conglomerates are comparatively rare. The measures lie almost horizontally, with only a very slight

[1] Clarke, J. M., New York State Museum, Memoir 9, pp. 92-96, 1908.

eastward dip. Cross bedding is common. The formation overlies the Nipisiguit granite, and a number of contacts are exposed on the Nipisiguit. Nowhere was a true basal conglomerate seen, the basal bed usually being an arkose several inches, to a foot or so, thick. The curious mammillary outlines of the planes of contact between granite and sediment, as well as the regular concentric parting planes in the plutonic rock, have already been mentioned.

The absence of basal conglomerates, the presence of an arkose apparently derived from the granite directly below, the mammillary outline of the contact plane and the concentric partings in the granite, so like exfoliation planes, all suggest an æolian origin for at least a part of the Bathurst formation. The presence of fine shales and the occasional beds of conglomerate seem to negative this supposition. As the district in question seems to lie about on the last shore-line of the advancing sea of Carboniferous time, possibly æolian and aqueous deposits may have irregularly alternated with one another prior to the more permanent submergence during the time of the formation of the Millstone Grit, beds of which outcrop not far to the east, and apparently conformably succeed the Bathurst beds.

Quaternary.—Stratified gravels, sands, and clays, accompanied by distinct terraces, occur along the lower slopes up to heights of 250 feet to 300 feet. Boulder clay occurs, and in one section was observed to hold interstratified, cross-bedded layers of sand. Over considerable areas the country is completely mantled with boulders, often of large size. Certain hills are apparently composed of tumultuous aggregates of boulders of all sizes that seemingly have been glacially transported. Imperfectly preserved glacial striæ were observed at a few points within the area examined in 1908, but none were recorded during 1909. The transported material, so widely distributed over the whole country, is of rocks such as underlie the district or are believed to occur farther inland. The imperfect evidence collected apparently indicates that, at least in the last recorded stages of glacial times, the movement of the ice sheet was northward and outward from the interior of the Province.

ECONOMIC GEOLOGY.

The main interest of the district, as far as economic geology is concerned, centres about the iron ore deposits of the Nipisiguit river. Within the area examined this year, manganese deposits also occur, on Tetagauche river near the falls above the last road bridge. The Nipisiguit granite has been quarried to a small extent, the stone having been used for bridge piers on the Intercolonial railway, also for certain buildings in Bathurst, etc.

Iron.

The Nipisiguit iron deposits are found on both sides of Austin brook where it empties into Nipisiguit river at a point about 16 miles south-southwest of Bathurst. The deposits are the property of the Canada Iron Corporation. This Company is, at present, completing a railway running from the site of the ore bodies, along the west side of the Nipisiguit to a point of junction with the Intercolonial railway, not far from where this railway crosses the river. When completed, the new line will have a length of about 16 miles.

Up to the end of September—with the exception of the sinking of eight diamond drill holes, and a very slight amount of stripping—little development work had been done in connexion with the ore bodies, the energy of the Company being chiefly directed toward the completion of the branch railway.

Austin brook, where it joins the Nipisiguit, flows about south-southeast, in a narrow valley with steep sides rising 60 feet to 80 feet above the floor. East of the brook, the country is comparatively level; west of the stream, the land rises in a

broken ridge bounded on the west by a depression somewhat analogous in size and course to that occupied by Austin brook. One ore body lies west of Austin brook, running in a southerly direction between that stream and the Nipisiguit; the remaining ore bodies, in two groups, lie east of Austin brook.

Nearly the whole of the surrounding country is heavily wooded, rock exposures are comparatively rare, and, altogether, there are only ten exposures or groups of exposures showing ore. The conditions, therefore, are very unfavourable to the study of the nature and forms of the deposits. The following statements are, in a measure, provisional only, pending a more detailed study of the evidence collected.

The ore bodies lie within the area of the Austin Brook quartz porphyry already described, and near a considerable body or a number of dikes of the so-called diabase. They have sharply defined walls, are largely of magnetite, and apparently have the forms of steeply-dipping, flattened lenses, the major axes of the outcrops trending nearly north and south. The character of the ore is indicated by the following figures derived from the results of nearly 70 analyses of samples taken at intervals of 10 feet from the cores of four diamond drill holes. The logs of the drill holes and accompanying analyses were very kindly placed at the disposal of the writer by Mr. Fulton, the local manager of the mining company:—

Iron, average, between	47·0% and 51·0%;	range, 39·6% to 58·7%
Sulphur, average, between	0·17% and 0·27%;	range, 0·009% to 2·433%
Phosphorus, average, between	0·77% and 0·89%;	range, 0·385% to 1·222%

The ore consists largely of magnetite, with sometimes a considerable proportion of hematite. Fine quartz, and probably various silicates occur through it, giving the ore a finely-banded appearance. Quartz in small and large, often crenulated veins, is common; the mineral also forms comparatively large lenticular-like aggregates. Pyrite is somewhat abundant along narrow zones, and in some instances is very abundant in the foot-wall. At times the nearly pure sulphide forms lenticular aggregates nearly a foot in diameter. Within the ore body were observed narrow, discontinuous bands of nearly pure, fine silicates, perhaps representing altered country rock. In common with the country rock, the ore exhibits a prominent parting, or schistosity, striking about north and south or parallel to the direction of the main axis of outcrop. In the ore itself, this is accompanied by an apparent banding simulating bedding; the zones of quartz veins, of sulphide, and of intermixed or interbanded gangue, all follow the same direction, and all, at least roughly, dip parallel with the walls of the body.

Because of the lack of a sufficient number of natural or artificial exposures, any estimate of the size and general attitude of the ore bodies must largely depend on the evidence furnished by the diamond drill holes, and on the magnetometric survey by E. Lindeman of the Mines Branch. The outcrops are too few and too scattered to yield definite results.

According to the plan of the magnetometric survey, confirmed by the distribution of the natural exposures, the ore bodies lie in three main groups, the longer axes of which, at the surface, run, roughly speaking, north and south.

The body lying west of Austin brook, and known as No. 1 deposit, is, at its northern end, exposed over its full width. At this point the outcrop had a width of about 150 feet, with sharply defined walls dipping westerly at an angle of about 45°, giving a true thickness to the body of about 105 feet. A vertical drill hole sunk in the hanging-wall near this point, entered ore at a depth of about 40 feet and indicated a true thickness of about 90 feet. A second vertical drill hole bored at a point about 700 feet farther south, intersected ore at a depth of 50 feet, and yielded a calculated thickness of nearly 80 feet. A third drill hole, started at a place about 500 feet west of the last, and inclined toward the east at an angle of 20°, cut ore at an equivalent vertical depth of 410 feet—where the ore body appeared to be about 65 feet thick. The results of the magnetometric survey indicate that, the ore body extends at least 1,000

feet farther south, or, over a distance in all, of about 2,000 feet. As far as present knowledge goes, the walls apparently preserve a nearly uniform southerly strike and westerly dip, the angle of dip, in the northern half, being about 45°.

A second body or group of ore bodies, known as No. 2, lies east of Austin brook, the southern end commencing on the valley slope at a point about 1,000 feet east of the apparent end of No. 1. The course of the axis of the second body diverges about 23° from that of the first. At the southern end a group of outcrops has a maximum width of a little over 40 feet, with nearly vertical walls. The southern extremity is well exposed, and the body is seen to end in a number of irregular fingers projecting into schistose country rock. Northward, ore outcrops at a few points for a distance of about 1,200 feet, and the indications are that the body remains at about a constant width, forming a comparatively narrow band. The magnetometric survey points to a horizon of practically the same length, but containing two ore bodies following one another along the strike.

A third ore body or group of ore bodies known as No. 3, lies east of Austin brook, and about in line with the prolongation of the axis of No. 1: commencing at a point about 1,800 feet north of it. Four diamond drill holes have been placed in this body, but the results of one only are at present available. The log of this drill hole, together with the position of surrounding exposures, indicates a body of ore about 100 feet thick, dipping west at an angle of about 75°. In this instance, the drill passed through ore from a point about 20 feet below the surface to one 350 feet beneath it. Exposures of ore occur at the surface over a length of only 300 feet, but the magnetometric survey of E. Lindeman, supplemented by one carried out by Mr. Fulton of the Canada Iron Corporation, indicates an ore-bearing horizon of much greater length: perhaps totalling in the neighbourhood of two-thirds of a mile. It is possible that over this distance the ore may occur in more than one distinct body, and the magnetometric surveys also seem to indicate the existence—along a parallel line a few hundred feet west—of other bodies.

Besides the above main bodies, an outcrop of iron ore was seen in one of the cuttings on the line of the new railway not far above the falls on the Nipisiguit. The presence of other bodies of ore in the district is to be expected, but their discovery is practically possible only by making use of magnetometric methods.

All the information available seems to indicate that, the deposits have the form of beds varying in width from a maximum of 105 feet to a minimum of about 40 feet. In all cases the walls are sharply defined, and dip westerly at angles ranging from 45° to nearly 90°. The three groups of ore bodies do not seem to represent one original zone separated into three by faults, since, in the case of No. 2 body, what appears to be an original, natural end, is exposed.

The country rock of the three deposits is believed to be, in the main, quartz porphyry, or as is more commonly the case, a schistose derivative. In that rock the planes of schistosity in country rock and ore are, on the whole, parallel to one another, and to the bounding planes of the ore bodies and lines of banding in the ore. The ore bodies seem to have suffered from the forces producing the schistosity of the country rock, and, at the same time, to have been guided in assuming their positions by the greater degree of schistosity of the country rock along certain zones. The visible end of No. 2 body seems to indicate that the ore penetrates the country rock—not that the country rock was later than, and penetrated the ore.

The invariable presence of a rather high amount of phosphorus in the analyses indicates a considerable amount of apatite, a mineral whose presence in bulk usually indicates a direct or indirect igneous origin, and not a sedimentary origin nor one analogous to that of the more common types of veins. The very general presence of quartz veins in the ore and their absence or comparative uncommonness elsewhere, strengthens the above deduction, and weakens the argument for a sedimentary origin of these bodies, which their bedded-like forms at first view suggests.

The present conclusion is, that the ore bodies are of pegmatitic types, and that their formation has been due to the action of forces accompanying or following igneous invasion or invasions the results of which are not otherwise apparent; they do not seem to have been directly associated in origin with the quartz porphyry. If this view of the origin of the ore bodies is the correct one, it seems highly probable that their true shapes are those of very flattened lenses; that the depths to which the individual lenses extend will prove to be, on the whole, not much greater than their maximum extension at the surface; and that the lenses will, as they approach their limits, thin out and end—as far as mining is concerned—rather rapidly.

(In the above considerations, the presence of the pyrite has been only briefly touched upon, since study has not sufficiently far advanced to determine, with any degree of certainty, the relative age of this mineral.)

Manganese.

A quartz vein carrying manganite, cuts red slates on the south bank of the Tetagauche above the last road bridge, and only a short distance below the falls on the river. The deposit was worked a number of years ago, but the tunnel leading in on the vein is now caved in, thus preventing any detailed examination. At its outcrop on the steep river bank, the vein is seen, in places, to be at least 13 feet wide, to be nearly vertical, and to be accompanied by roughly parallel, narrow veins. The quartz is coarse, and white in colour; it forms most of the vein, the manganite occurring in narrow seams and small patches or aggregates of plates, or in semi-detached, imperfect crystals or fine grains. The vein is irregular in outline, holds inclusions of country rock, and is much fractured. From information gained from nearby residents, it is believed that during mining operations solid or nearly solid ore was found to occur in pockets. Manganite, in small quantities, also occurs in the dump of several shallow trenches sunk a short distance back from the river, at a point several hundred yards farther down stream.

SUMMARY REPORT OF THE WORK OF THE LATE MR. HUGH FLETCHER IN NORTHERN CUMBERLAND COUNTY, NOVA SCOTIA. COMPILED FROM HIS JOURNAL BY R. W. ELLS.

Mr. Fletcher left Ottawa for Nova Scotia on June 16, to continue the study of the geology of the northern portion of Cumberland county, including the large areas underlain by Permian or upper Carboniferous strata extending northward to the shore of Northumberland strait.

The more important portion of this work was, apparently, the separation of the areas underlain by lower Carboniferous shales and gypsum from those occupied by the Millstone Grit and Productive Coal Measures; and the determination, as far as possible, of the horizons of the small coal seams which occur along the northern border of the coal basin, between the Joggins shore and the Styles coal mine, north of Springhill Junction. The mapping of the Permian strata was also considered specially important. All these formations have been closely studied in former years in the areas to the east and south. In this work he was assisted by Malcolm McLeod, and John D. Mackenzie, both of whom had been his assistants in former years.

The detailed mapping of the district proceeded satisfactorily until the middle of September, when, on the 15th of the month, on a trip from Springhill to the Joggins coal mines, Mr. Fletcher contracted a cold through getting wet in a rain storm, and was seized with a chill which speedily developed into a severe attack of pneumonia. In spite of the best medical skill and nursing procurable he died, after a week's illness, at the residence of Mr. Baird, in the village of Lower Cove, Cumberland county.

From Mr. Fletcher's notes—taken from his journal—it would appear that a large portion of the season was spent in examining in detail the somewhat faulted area extending from the vicinity of Chase Lake brook and Black river—both branches of Philip river—westward to the shores of Cumberland basin near the head of the Bay of Fundy. In this strip of country lying north of the main Springhill coal basin, are a number of collieries, including the Styles mine on the east, north of Springhill Junction, and the Joggins colliery on the west, on the shore of Cumberland basin. Some of these have been worked more or less successfully for a number of years, and the tracing out of the horizons of the several seams on which they are located, engaged much of Mr. Fletcher's time.

The relations of the several divisions of the Carboniferous are somewhat complicated throughout this area, owing to the presence of faults and overlaps. While no definite results of the careful surveys carried on throughout the season by himself and his assistants are yet available, the field notes show that explorations were conducted throughout the entire area north of the Springhill and Joggins coal basins to the shore of Cumberland basin, where the lower portion of the celebrated Joggins section of the Carboniferous rocks begins. It is believed that the work of the past season, ended so abruptly as it was, will, when put in order, do much to solve the peculiar geological structure of this district.

In connexion with the work in this district, a visit was made in June by Mr. Fletcher, with Mr. R. W. Ells, to the district in the neighbourhood of Dorchester, New Brunswick. This visit was made for the purpose of determining more precisely the limits of the lower Carboniferous, Millstone Grit, and Permo-Carboniferous or Permian formations which extend across the interprovincial boundary into Nova Scotia, where Mr. Fletcher's work was being carried on.

From June 21 to July 1, Mr. Fletcher spent much time in consultation with the managers connected with the coal mines of the Springhill basin and those nearer the Joggins shore. Subsequently, some time was devoted to a closer study of several of the smaller coal seams which have been opened in this area.

After some days spent with his assistants in northern Cumberland, Mr. Fletcher went to Cape Breton on July 20, and in company with Mr. R. Smith, and Mr. W. Campbell, examined certain copper deposits near Campbell pond. Of this area he remarks that, in the bed of a small brook there is a vein of white quartz about 20 inches wide, holding a little shattered rock—a reddish, greenish, and grey felsite, with epidote, chlorite, and other minerals—which has been worked to a small extent. Branches from the main vein extend into the wall rock, some of which show copper staining, while a little hematite occurs along planes of shattering. About seven years ago, Messrs. James McDonald, Judge Finlayson, and others, sank a shaft to a depth of 65 feet on this vein, in the bed of the brook. The vein at the shaft runs about north and south, but away from the shaft breaks up or swings more to the southeast. At the bottom of the shaft (at present worked about 14 feet above the original 65 ft. bottom) the dip of the vein is flatter than at the surface, where it is nearly vertical. Cuts have been made in various directions at the 51 ft. level, but do not show much copper. At some places near the surface, however, the quartz is well mineralized with pyrite, copper glance, etc.; but a very large proportion of the vein matter taken out is quite barren. A good showing is seen in a trench on the surface. The vein, considering the formation in which it occurs, is persistent, although in places it breaks up into stringers. The shaft is dry, the brook carrying no water in the dry season. The ore is apparently not present in sufficient quantities for profitable extraction.

Some days also were spent in an examination of the Richmond coal field, with Mr. Mellinger and others interested in the structure of that coal basin.

Returning from Cape Breton, a study was made by Mr. Fletcher and his assistants of the somewhat complicated structure near the Leicester road, east of the Styles mine. Along the road the relations of the lower Carboniferous, the Millstone Grit, and the Permian are somewhat intricate. Indications of faults, in the form of slicken-sides and broken strata, are numerous, and while characteristic Permian beds are exposed at a number of places, certain of the higher beds are possibly Triassic.

Of the Permian, he remarks that the outcrops seen on the road to Shinemecas include, in addition to the usual red beds of that formation, conglomerates and reddish and whitish sandstones similar to those which occur with the upper Permian in the Joggins section. Some of these Permian rocks are slickensided, polished, veined, and drused with quartz and hematite, and are so much altered that they resemble the conglomerates at Arichat, in Cape Breton, which have been mapped as Devonian.

In August, from the 10th to the 20th, an examination was made of the area between Springhill and Thompson station, and of the country adjacent to Philip river and in the vicinity of Roslin, Hansford, etc., where certain areas of gypsum show unconformity, due in part to faults and in part to overlaps.

On August 23, Mr. Fletcher went to New Brunswick, where he met R. W. Ells, and W. J. Wilson, of the Geological Survey, and Dr. Henderson of London, England, who was boring for oil and natural gas in certain areas in the counties of Albert and Westmorland. This excursion extended as far west as Norton between Sussex and Hampton, where the bituminous Albert shales and their relations to the Perry conglomerates at the base may be seen. Mr. Fletcher was much interested in this area, as it enabled him to make a comparison between these New Brunswick rocks and those which in Nova Scotia he had for some years closely studied about Minas basin and in the county of Antigonish and elsewhere.

On September 3, Mr. Fletcher, accompanied by Mr. Tennant of Amherst, went to Williamsdale, about 8 miles south of Oxford Junction, in Cumberland county, to

examine the 'Arsenic mine,' reported as occurring at that place. His notes state that the deposit of ore—which is said to be gold bearing—occurs on a small brook about 2 miles east of Collingwood corner. In the bed of this brook, about half a mile from the main road, there is a belt of laminated rock with veins of quartz up to a foot in width, the belt having a maximum thickness of 6 feet. The direction of the largest veins and of the 6 ft. belt is apparently about N 10° E, and the angle of dip about 60° (varying from 30° to 90°). Some surface work on the outcroppings in the bed of the brook had been done for a distance of 70 feet, 30 feet of which contain great quantities of arsenical pyrites in ragged lenses or bunches. The ore is reported to contain $7 in gold to the ton, and a little silver. No work has been done below the brook level; but, if possible, a slope will be driven down following the richest bunch of ore. The veins appear to occur in the ordinary greenish and dark diabase and felsite of the neighbourhood. Dark Silurian slates containing graptolites occur a short distance up stream. The deposit thus resembles in its mode of occurrence, that at Peleg brook, where similar veins were first exploited for gold. The deposit is interesting, and may be of value. Several tons of ore have been mined and shipped.

Prior to his final illness, the last few days of Mr. Fletcher's work were spent in renewed attempts to solve the complicated problem of structure connected with the coal outcrops found along the northern margin of the Springhill basin, as far east as the Styles mine.

TUNGSTEN DEPOSIT OF MOOSE RIVER, NOVA SCOTIA.

(E. R. Faribault.)

INTRODUCTION.

On December 15, 1909, the writer left Ottawa for Nova Scotia, under instructions to make an examination of the tungsten-bearing deposit of scheelite, discovered in the spring of 1908, near Moose River Gold Mines, in Halifax county. The work was undertaken for the purpose of studying the character and structure of the deposit, and to help, if possible, in planning development work.

This deposit had been examined by the writer in October, 1908, when a survey was made of the then known scheelite veins, and in the Summary Report for that year, some notes were published on the discovery, character, and probable structure of the deposit.[1]

On Moose River sheet, No. 50, published by the Geological Survey in 1893, the location and the anticlinal structure of the veins are indicated, although not until ten years afterwards were these veins known to carry the tungsten-bearing mineral scheelite. The same year, a special plan of the Moose River gold mines, situated 2 miles east, was published, with some notes giving details of the structure of the gold-bearing veins, which closely resembles, in many respects, that of the tungsten veins.[2]

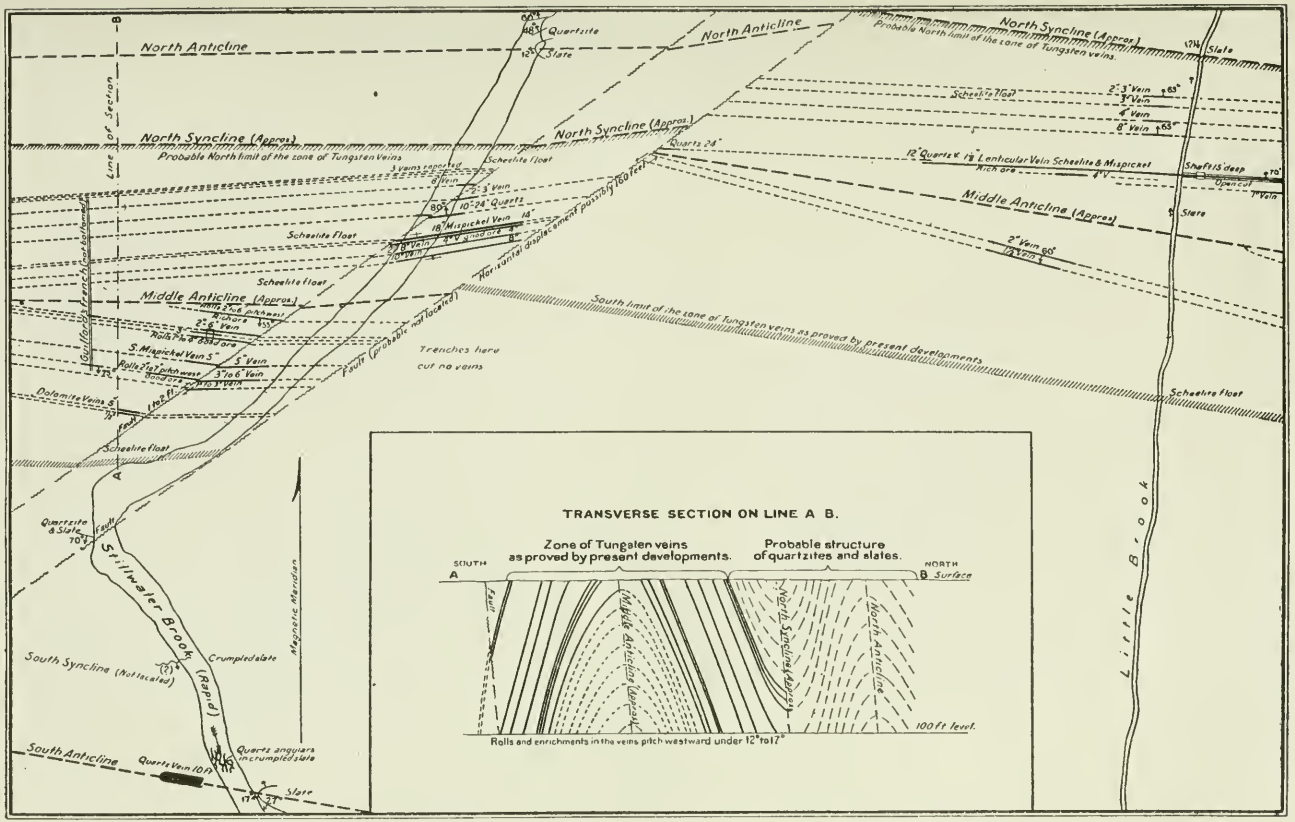
At the last visit, it was only possible, in the two days at my disposal—with the assistance of the original discoverers and prospectors, Reynolds, and Currie—to make a compass and chain survey, and a hasty examination of the area prospected. From these surveys and those previously made, two plans were compiled: one, on a scale of 250 feet to 1 inch, giving the general topographical features of the district and the distribution of the tungsten veins; the other, 60 feet to 1 inch, accompanied by a section, showing the structure of the veins discovered and their probable extension at the surface and in depth. A reproduction of the latter plan and section, on a reduced scale, is published herewith.

The tungsten deposit is situated in Halifax county, 28 miles northeast of Halifax city, 12 miles directly north of Ship harbour on the Atlantic coast, and 2 miles west of Moose River Gold mines. It is located on Stillwater brook, a branch of Fish river flowing south through Ship Harbour Grand lake to the Atlantic. Moose River Gold Mines is the post-office name of a mining centre surrounded by woodland. It is reached by a good mail-coach road, running southeast for 34 miles from Shubenacadie, a station on the Intercolonial railway, 40 miles by rail from Halifax. Thus, the distance by coach and rail is 74 miles from Moose River to Halifax. When the Eastern railway, projected between Halifax and Canso, is constructed, the tungsten deposit will be less than 8 miles from a railway.

GENERAL GEOLOGY.

The rocks of this district consist of beds of altered, grey quartzose-sandstone or quartzite, generally called 'whin,' interstratified with beds of dark grey slate. They are the lowest known strata of the Goldbearing series in the Province, and occur along the apex of the highest and most prominent anticlinal fold which passes through the Moose River gold district. Thus, the lower or Goldenville division of the Gold-

1 Summary Report, Geological Survey, for 1908, pp. 155-158.
2 Summary Report, Geological Survey, Vol. X, pp. 113-114 A.



PLAN AND SECTION SHOWING PROBABLE STRUCTURE OF INTERBEDDED TUNGSTEN VEINS

MOOSE RIVER. HALIFAX COUNTY, N.S.

By E.R. Faribault

Scale 120 feet to inch

100 50 0 100 200 300 400

bearing series attains, here, its maximum thickness, estimated at 16,000 feet, which, added to the 11,700 feet of slate of the Halifax division, as exposed on Black river, in Kings county, gives a total thickness of 27,700 feet for the whole series.

The country is drift covered, and rock exposures are very scarce; but taking advantage of the rock exposures offered by the prospecting done last summer, together with the natural sections of rocks exposed along Stillwater brook, it has been possible to work out the geological structure with a fair degree of certainty and accuracy. The conclusions reached confirm those advanced in last year's report.

The accompanying plan and section show that, on the apex of the major anticline, and within a space of 620 feet in width, the strata have been folded into three minor anticlines and two synclines, the axes of which have a general east and west course and pitch westward at low angles, varying between 12° and 17°.

A small fault has been located, cutting a 10 to 24 inch quartz vein, exposed in the bed of the brook, and also two veins, uncovered on the west side of the brook. the fault the strike of the strata is deflected towards the north, and on the north limb displacement of 1 to 2 feet in a southwesterly direction. On the southeastern side of the fault of the strike of the strata is deflected toward the north, and on the north limb of the anticline the beds dip at higher angles than in the corresponding positions on the west side of the fault. This dislocation, the general structure of the strata, and the fact that search made on the eastern side of the brook for the continuation of certain veins uncovered on the western side has proved unsuccessful, indicate that there is, probably, a second and more important fault, situated about 50 feet southeast of the one just described. The location and magnitude of this second, inferred fault have not been accurately determined. It is estimated, however, that the block of strata on the southeastern side of the fault has been displaced, horizontally, for about 160 feet to the northeast; but, as yet, there is nothing to show the extent of the verical displacement nor the angle of dip.

The north anticline is well defined in the west fault-block on the left bank of Stillwater brook, 40 feet below the bridge, where a bed of slate, exposed at low water, was observed to curve and pitch westward at an angle of 12°; but the axis has not been located in the east block.

The north syncline was not exposed in the west block, and its location in the east block, along the little brook, is doubtful.

The position of the middle anticline is fairly well established in the east and west blocks by the evidence furnished during surface development made last summer, which places this line farther north than it was thought to be when last year's report was written. This anticline is the most important from an economic point of view; for all the tungsten veins so far discovered are situated on one side or the other of this axis.

The south syncline could not be located in either of the blocks.

The south anticline is well exposed in the east block, in the bed of the brook, where, at low water, a bed of slate may be observed to curve around on the arch of the fold and to pitch west at an angle of 17°; also, on the western shore, where a vein of coarse, white quartz, 10 feet thick, apparently forms a prominent saddle, pitching westward on the arch of the fold. Immediately north of this anticline and for a short distance up the brook, the strata are much crumpled and fractured, and are cut by irregular masses and stringers of quartz, indicating the possibility of small undulations occurring in this vicinity, and, possibly, for some distance down the brook, where the rocks are concealed.

The Moose River anticline, traced westward, at a distance of 36 miles, passes through the Waverley gold district, one mile to the north of which were discovered, last year, a few interbedded scheelite-quartz veins, similar to those of Moose River. Toward the east, it divides into two major anticlines, the southern one passing through Beaver Dam gold district at a distance of 12 miles from Moose River, and

the northern one through Fifteenmile Stream gold district, 24 miles distant. The Moose River anticline has been accurately located on the map-sheets Nos. 41, 49, 50, 54, 55, and 67 published by the Geological Survey.

No igneous rocks have been found in the immediate neighbourhood of these deposits, the nearest intrusion being a large mass of granite, 7 miles to the southeast. It is possible, however, that granite underlies this area of sedimentary strata at no great depth, for at several places the slates have been altered into a knotted phyllite, and the quartzite into a quartz-schist.

ECONOMIC GEOLOGY.

The history of the discovery, and the general character and composition of the tungsten-bearing veins were described in last year's Summary Report. The development work done last summer by Messrs. Reynolds and Currie has resulted in the discovery of several veins, and has furnished much valuable data bearing on the general distribution and geological structure of the deposit.

All the scheelite-bearing veins so far discovered, may be classed as interbedded veins; for they coincide with the bedding planes, and occur in thin layers of slate, interstratified with beds of quartzite. The veins are distributed in equal numbers on the north and the south limbs of the middle anticline, forming a well-defined system of saddle veins, similar in structure to those of the gold deposits of the Province. The section drawn across the anticlinal fold on the west side of Stillwater brook shows nine veins uncovered on the south limb and about as many on the north, all situated within a space of 150 feet wide.

The veins on the north limb are, from their interbedded character, necessarily parallel to one another, and the same is true of those on the south limb; but as the axis of the anticline pitches westward, the two sets of veins converge toward the west until they meet on the anticline, where they underlie one another in the form of saddle-veins.

The width of the veins varies from a fraction of an inch to 24 inches, but few of them, and this is especially true of those showing the most scheelite, average more than 4 inches. They are generally quite uniform in width, though some of them show the enlargements and rolls, so common in the gold-bearing veins. These rolls plunge westward at low angles, which correspond with the pitch of the anticline, also approximately with the line of intersection of the cleavage and bedding planes, and may indicate, as in the case of the gold veins, the general pitch of the ore shoots.

The vein matter consists essentially of quartz, scheelite, and mispickel in varying proportion. The quartz is mostly translucent, white, and glassy, and quite different from that of the gold-bearing veins of the Province.

The scheelite is honey-yellow to pale reddish-brown in colour, is coarsely crystalline, and shows distinct cleavage. It often constitutes a large part of the smaller veins; in some of which it occurs in series of lenses or rolls. In the larger veins the scheelite is mainly confined to the outer parts, where it occurs in thin, irregular patches.

The mispickel is always massive, and varies very much in quantity in the different veins. In one or two of the veins it is the predominant constituent; but, generally, it is less abundant than the scheelite, and sometimes is scarcely visible. It also occurs abundantly in the slate adjoining the veins, in very minute, well-formed crystals, commonly surrounded by a narrow zone of white mica, with the scales at right angles to the surface of the mispickel.

White, crystalline dolomite has been observed in a few veins. Scattered through the veins are patches of fine, white, scaly mica, with a silky lustre; and embedded in the scheelite and quartz are slender needles of black tourmaline. At the outcrops and along the selvage of the veins, the scheelite is sometimes slightly decomposed into a

bright canary-yellow powder, which is tungsten acid, or tungstite; but no wolframite nor hübnerite has been observed. Galena, pyrite, and pyrrhotite, which are commonly found in the gold veins, have not been observed. Several assays of the ore for gold, made by Mr. A. L. McCallum, have given negative results in every case.

It is evident that the tungsten veins differ materially in composition from the gold veins of the district. The character of the veins, their constituents, the presence in them of mica and tourmaline, and the metamorphism of the country rock adjoining the veins, all tend to prove that the tungsten deposits are the results of deep-seated emanations, along a zone of fractures following the axial plane of the great Moose River anticline, at the close of the period of granite intrusion.

General Development.

All the prospecting has been confined, so far, to a comparatively small area, extending 700 feet east and west along the course of the veins and 200 feet across them. This work was all done by the two Reynolds brothers and Currie, and consists mostly of trenching across the strike of the rocks to prove the ground. Some of the veins discovered were traced along their courses for short distances by prospect pits and shallow open-cuts; and on one of them a pit was sunk to a depth of 15 feet. Considering the amount of work done and the limited area covered, the results obtained are very satisfactory.

Several tons of ore have been produced as a result of the prospecting already done. We are informed that one or two tons have been forwarded to Halifax and elsewhere, for the purpose of experimenting on a practical process of concentration, as well as to determine the best method of producing tungsten acid from concentrates and at the same time eliminating sulphur and arsenic. Although scheelite is richer in tungsten than the other ores of tungsten, wolframite, and hübnerite, it was for a time considered less desirable, owing to the difficulty of its metallurgical treatment; but the modern method of reduction, in the electrical furnace, has rendered it fully as desirable.

The zone of tungsten veins is probably limited on the north by the north syncline, situated at a distance of about 100 feet north of the middle anticline, and it probably extends some distance farther south than the present developments. Otherwise, the extent of the mineralized zone is not known; but enough veins have been exposed to show the importance of the deposit from an economic point of view. That the area is much larger than might be supposed from the veins exposed by Reynolds and Currie, is shown by the fact that, scheelite has been found in drift on the continuation of the same anticline, 900 feet west from Stillwater brook, and in an isolated boulder a mile and a quarter west. Further exploration will no doubt also disclose scheelite veins outside of the known zone, especially toward the south. Scheelite float has also been found 1,350 feet south, on the east side of Stillwater brook, where the first discovery was made. This material may have drifted south from the main deposit, or from another group of veins, possibly situated on another minor anticline not yet located.

Since the discovery of these deposits, scheelite was found 2 miles east, on the same anticline, at the Moose River gold mines, where, on the Touquoy property, at the depth of 200 feet in Kaulbach's vertical shaft on the Dowell lead, pieces of scheelite as large as a hen's egg, in quartz, were brought to the surface at different times; also on the Moose River Gold Mining Company's property, where, at a depth of 90 feet in the Cameron shaft, a pocket was found containing a few pounds of ore.

As already mentioned, scheelite was discovered last fall by Mr. A. L. McCallum, at a place one mile north of the Waverley gold mines, which are situated on the same anticline, 36 miles west of Moose River. Two or three interbedded quartz veins bearing scheelite, similar to those of the Moose River deposit, have been uncovered here, and a quantity, possibly two tons, of ore has been produced.

Scheelite has, therefore, been found at different places over a stretch of 3 miles along the Moose River anticline, and at another place 36 miles west, on the western continuation of the same great upheaval: indicating, seemingly, the persistence of this system of anticlinal veins, and its possibilities as a good field for further exploration.

Mr. F. H. Mason, chemist, formerly of Halifax, states that he has often found traces of scheelite in his analyses of the tailings from the Lake Lode mine at Caribou, situated 6 miles north of Moose River on the next main anticline. Professor T. L. Walker reports that concentrates collected at Caribou mines were found, on chemical examination, to contain 0·22 per cent of tungstic acid; and that a sample collected in June, 1908, at the Moose River mill, contained 0·52 per cent tungstic acid.

Scheelite, of a light, smoky colour, was found in a quartz vein intersecting the Middle Rabbit lead, on the Ballou gold mine, Malaga, Queens county. It is very probable that scheelite occurs in many other gold districts in Nova Scotia, especially in those situated near granite masses, and a systematic search for it over the old dumps and old workings may be rewarded by other important finds.

CONCLUSIONS.

From this preliminary study of the Moose River tungsten deposit, the following conclusions have been reached:—

The development work already accomplished has proved beyond a doubt that the deposit has a real, economic importance.

The structure and distribution of the tungsten veins are so intimately bound up with the rock structure that a consideration of the structure of the anticlinal fold and faults is necessary to its perfect understanding.

The general structure has been fairly well worked out at the surface; but much yet remains to be proved and determined with more accuracy and detail, both at the surface and in depth, before an attempt can be made to lay out a definite plan of operation that would give the best results.

It is very important to prove the existence, as well as the location and magnitude, of the fault, which has been described above as probably occurring on the east side of Stillwater brook; for such a fault would divide the mineralized belt into two distinct sections, each requiring to be independently developed, and, perhaps, also exploited.

It will no doubt be found desirable to develop the belt of mineralized veins by means of two shafts, one on each side of Stillwater brook, to a depth of about 100 feet; then to cross-cut north and south across the whole belt, and drive a series of drifts on the courses of the most promising veins intersected. The two shafts may be sunk vertically on the apex of the anticline, or on the dip of one of the best veins, situated nearest to the anticline, so as to keep in the centre of the zone of mineralization. To locate these shafts, it will be necessary to determine more accurately the position of the anticline on both the east and west sides of the brook.

There will probably be found, as in the gold veins, a series of well-defined ore-shoots of no great width, but of considerable length, pitching westward, approximately parallel with the plunge of the apex of the anticline, at an angle of about 12° to 17°. In the gold veins the ore-shoots generally vary from 40 to 200 feet in width; and several of them have been mined for lengths of over 1,500 feet along the pitch. But, owing to the low angle of the pitch, an ore-shoot may have a length, at the surface, of several hundred feet along the strike of the vein; while a shaft sunk on the dip of the vein may reach the bottom of the ore-shoot at a depth of much less than 100 feet; on the other hand, an ore-shoot, if followed westward along its pitch, may be found to extend much over 1,000 feet in length. To keep the development work in the zone of ore-shoots, it

may be found advantageous, for deep mining, to sink an incline shaft on the apex of one of the most promising veins, and to develop the overlying veins by means of cross tunnels and drifts at different levels.

A few hundred feet north of the deposit on Stillwater brook, a small amount of water-power is now available, which may be increased and developed to advantage, for utilization in mining development.

On Fish river—2 miles to the south of the deposit—there is a much larger available source of water-power which could be developed, and from it electric energy transmitted to the mine.

The mine is surrounded by woodland, which affords a good supply of both hard and soft wood, suitable for mine timber, as well as for fuel.

SOUTHERN PART OF LUNENBURG COUNTY, NOVA SCOTIA.

(E. Rodolphe Faribault.)

INTRODUCTION.

During the past season, the writer was occupied in completing the geological and topographical mapping of the southern part of Lunenburg county, along the Atlantic coast southwesterly from Mahone bay to Vogler cove, and extending inland to Bridgewater. This completes the surveys and other field work necessary to finish the Mahone Bay sheet, No. 88, and the Lunenburg sheet, No. 89.

The assistants in the field were Messrs. J. McG. Cruickshank, and M. Y. Williams.

For the purpose, particularly, of indicating the lines which prospecting should follow in the district, as well as to facilitate the work of operating mines, attention was given, in an especial degree, to the structural geology; since it has been established that the gold-bearing veins occur, almost exclusively, along anticlinal folds. The development in the rocks of a strong, slaty cleavage, obscuring the bedding planes, and the widespread drift cover, concealing the surface, made the accurate location of the various anticlines and synclines both difficult and tedious.

CHARACTER OF DISTRICT.

The district surveyed is for the most part covered by low, undulating hills of glacial drift, seldom over 300 or 400 feet high, having a general north and south trend and forming prominent headlands along the sea coast. The intervals between the hills are generally occupied by swampy land and chains of small lakes; or by rocky barrens affording good rock exposures; or they are strewn with granite boulders and debris from the north.

Lahave river crosses the area in a southeasterly direction, and occupies a marked depression: which is continued as an inlet of the sea, less than a mile wide, for 12 miles to Bridgewater, affording good navigation for large and small vessels. Petite Rivière, a stream of less importance, runs into the sea 6 miles farther west, and has several water-falls along its course that are partly utilized for small mills.

Lunenburg and Bridgewater, the two chief towns of Lunenburg county, are situated in the area examined. Lunenburg, the most important fishing station in the Province, has an excellent harbour, and has a large trade with the West Indies. Bridgewater is a progressing railway and lumbering centre at the head of navigation on Lahave river. Settlements of fishermen are scattered along the sea-shore of the mainland and islands: especially on many small, rocky coves and inlets which afford good shelter for boats.

In the vicinity of the coast there is little land suitable for agriculture. Small farms and gardens are successfully cultivated by the use of an abundant supply of fish refuse and seaweeds as fertilizers. Inland, between Bridgewater and Mahone Bay, there are good farms and several fine orchards.

GEOLOGY.

With the exception of a few small patches of lower Carboniferous limestone and gypsum on Second peninsula, and some of the adjoining islands, the whole area is occupied by the series. No rock exposure could be found on Second peninsula, because of a heavy covering of glacial drift; but numerous angular blocks of shell

limestone and grey compact limestone were observed at several places along the north shore, from the Government wharf to Bluff head, also on the north and south side of Mason island lying between the two peninsulas. These deposits indicate the position of the outer edge of the lower Carboniferous basin of Mahone bay and St. Margaret bay referred to in the Summary Report for 1907, page 79.

Several specimens of invertebrate fossils, obtained in 1907 and 1908 from various localities in the Mahone Bay basin, were examined by Mr. Lambe, who reports that they consist of one species of coral and two species of brachiopods: all characteristic of the lower Carboniferous limestone. The respective species, together with the localities from which they were obtained, and Mr. Lawrence M. Lambe's descriptions, are as follows:—

(1) *Lithostrotion Cæspitosum*, Martin.—Specimens from Sheep island, Goat island, and the south end of Stephen island, in Mahone bay. These specimens are of interest, as the species has not hitherto been recorded from this side of the Atlantic. *L. cæspitosum* was originally described from the Carboniferous limestone of England.

(2) *Dielasma Sacculus*, Martin.—Half a dozezn specimens, from Mahone bay, belong to this species, which was primarily described under the name of *Terebratula sacculus*, also from the lower Carboniferous of England, and was later recorded as occurring in rocks of the same general horizon by Sir J. William Dawson (see Acadian Geology) at a number of localities in Nova Scotia.

(3) *Productus Cora*, D'Orbigny.—Specimens of a large Productus from Goat island, Sheep island, south end of Stephen island, Seaboyer's on south side of Deep cove, and north shore of Second peninsula. The species represented appears to be an unusually large form of *P. cora*, d'Orbigny, which is found abundantly, but of smaller size, in the Carboniferous limestone of Nova Scotia, and is widely distributed in the Carboniferous of Europe as well as America.

Goldbearing Series.

Practically the whole of the district examined, with the exception of the small areas of lower Carboniferous limestone and gypsum on Second peninsula, is underlain by the quartzites and slates of the Goldbearing series. In the absence of fossils or other conclusive evidence, this great series of rocks has been referred to the lower Cambrian, though, possibly, it may be Pre-Cambrian.

The whole series falls naturally into two distinct lithological divisions: a lower one, called the Goldenville quartzite; and an upper one, called the Halifax slate.

The Goldenville division is mostly composed of thick-bedded, bluish and greenish grey quartzite, locally called 'whin,' interstratified with numerous beds of slates of different varieties and colours, and from a fraction of a foot to several feet in thickness. This division constitutes the productive gold-bearing rocks of the Province.

The Halifax division is made up of argillaceous slates, generally of a dark grey colour, in many places graphitic and pyritous, and varying to greenish-grey or light grey in colour. Some beds are quite arenaceous, with occasional thin layers of flinty, quartzose rock, generally heavily charged with iron pyrites.

The rocks of the Goldbearing series in the region examined have been forced into a succession of parallel folds, running northeasterly and southwesterly.

The greatest width of the area of the Goldbearing series in the district examined, measured at right angles to the folding, is 16 miles. A transverse section along a line from Bridgewater to West Ironbound island gives eight major anticlines and seven synclines, with a few minor folds. The courses of the axes of folding were all located and traced across the area surveyed.

The following list of anticlines and synclines, gives the order in which they occur along Lahave river from West Ironbound island to Bridgewater, together with the gold mines situated along the anticlines:—

Moser Island anticline.
1. Spectacle Island syncline.

Dublin Shore anticline. The Ovens gold mines.
2. South Parks Cove syncline.

Park Creek anticline.
3. North Parks Cove syncline.

Pentz Section anticline. Indian Path mine and Somerset gold discovery.
4. Middle Lahave syncline.

Wentzel Lake anticline.
5. Pleasantville syncline.

Juniper Brook anticline.
6. Upper Lahave syncline.

Conquerall Bank anticline. Dares Lake gold discovery.
7. Dayspring syncline.

Bridgewater anticline. Leipsigate and Blockhouse gold mines.

As already stated, the greater part of the area is occupied by the Halifax slate division. The Goldenville quartzite is brought up to the surface only in the south-western part of the Lunenburg sheet, where the Dublin Shore anticline and the Pentz Section anticline have a pronounced pitch to the eastward, forming two prominent, broad domes of quartzite extending southwesterly beyond the limits of the area examined.

The southern dome of quartzite begins on the sea-shore half a mile east of West Dublin post-office, spreads out in a broad circle and extends southwesterly on both limbs of the Dublin Shore anticline, including Green bay with the inner part of Cape Lahave island on the south, and the mouth of Petite Rivière and the head of Broad cove on the north.

The northern dome of quartzite begins 3 miles to the northwest of the southern one, on the eastern side of Petite Rivière, 1 mile east of Crouse Town post-office, where it circles around Brown lake on the eastern pitch of the Pentz Section anticline; the south limb extends southwesterly toward Vogler cove, and the north limb westerly toward County Line station on the Halifax and Southwestern railway.

On these two domes the interstratified slates, at certain horizons, are in much greater volume than the quartzites, especially near the top of the division, where they attain a great thickness. The line of demarcation between the two divisions is thus not nearly so well defined in this district as it is in the eastern part of the Province, the passage from quartzites to slates being more gradual.

Igneous Rocks.

The only igneous rocks observed were four dioritic dikes on the Ovens peninsula. The dikes are well exposed on both the east and west side of the peninsula, at a distance of a quarter of a mile south of the Ovens gold mines, and immediately south of the old mill of the Acadia Gold Reduction Company, still standing on the eastern shore of the point. All four occur within a distance of 250 feet; they vary in width from 3 to 9 feet, and are generally conformable in strike and dip with the stratification of the slates, though in many cases, they distinctly cut across them. The only other instance of a basic eruptive occurring in the Goldbearing rocks along the coast is at Tangier, where a dike cuts across the sediments at right angles to their strike. In the Gaspereau valley and its vicinity many similar dikes have also been observed intruding both the Goldbearing series and the Silurian.

Glaciation.

The entire area must have been covered with moving ice at the time of the glacial period. The general course of the ice, as indicated by striæ, was toward the south and southeast, conforming to the directions of the valleys of Lahave, Petite Rivière, and other main streams, and to the general trend of the hills. Glacial drift, largely made up of till, with granitic boulders, and of debris transported from South mountain, covers most of the hills. Debris of amygdaloidal traps and other characteristic basic eruptives from North mountain on the Bay of Fundy coast, was also observed at many places, showing that at some period, at least, the ice field moved across the whole Province.

ECONOMIC GEOLOGY.

Gold.

The slates of the Halifax division of the Goldbearing rocks are generally considered by the miners to be much less likely to bear auriferous veins than the quartzites and slates of the Goldenville division, because, so far, no important mine has been located on them anywhere within the Province; except at Caribou. Rich veins have been found in them, but these were generally small and irregular, and without the uniformity and extent of those occurring in slate belts lying between rigid walls of quartzite. It may be remarked, however, that in the eastern part of the Province, on account of the deep glacial erosion, the slates of the upper division seldom occur along the anticlines, and much less often on the domes which are the only favourable places for the formation of gold-bearing veins.

In the region under study, every one of the eight anticlines occurs in the slate of the Halifax division, and only two of them have brought the quartzites to the surface, namely, the Dublin Shore and the Pentz Section, where these rocks occur at the southwestern end of the anticline. The Dublin Shore anticline passes through the 'Ovens' gold district, and the Pentz Section anticline passes through the Indian Path gold district and the Somerset gold discovery. Special detailed surveys have been made of the gold mining districts of the Ovens and Indian Path, but a report on the structure of these districts must be deferred until all the surveys are plotted and compiled.

Somerset Gold Discovery.—On May 20, 1905, rich 'float' gold quartz was discovered by Nathaniel Slaughenwhite of Italy Cross, at Somerset, on the west side of Petite Rivière, one mile south of A. Slaughenwhite's house, at the south end of Beach hill. The quartz is dark, ribboned, and striated, indicating that it came from an interbedded vein having a thickness of about 10 inches. During the following two summers a surface pit was sunk 63 feet north of the first discovery through 26 feet of drift to the bed-rock, and a tunnel was driven north for 57 feet, on the bed-rock. No float of the rich ribboned quartz was found in this exploratory work. This may have been due to the fact that the discovery is situated on the eastern pitch of a broad anticlinal dome of quartzite and slate, where the veins, conforming to the stratification, have a general north and south direction. East-west, or at right angles to the probable direction of the vein, should, therefore, be the more promising direction for exploratory tunnelling.

The same rule should be applied in prospecting at the Augustus Reinhardt discovery of rich gold float, similarly situated on the same anticlinal dome, about one mile west of the Slaughenwhite discovery.

Iron Ore.

Some of the dark, rusty-weathering slates of the Halifax division are heavily charged with iron pyrites, generally occurring in small cubes distributed through the rock, or in massive form along the bedding planes. From the decomposition of these

slates have originated deposits of bog iron ore found in various low, swampy places, along rivers, and about lakes. Several such deposits were observed, notably along both banks of Lahave river, and on the hill extending to the north of Kingsbury to Rose point. It is doubtful if any of these deposits are of sufficient extent and depth to be of commercial value, but they might be worth investigating, as they are nearly all situated within easy reach of good shipping points.

Limestone and Gypsum.

The presence of limestone on Second peninsula appears to have been generally overlooked by the present inhabitants, though it was certainly known to the earlier French settlers, who had a limekiln on Limestone hill, opposite the Government wharf, and one on Goreham point, once thickly settled by the French.

Gypsum was not observed anywhere, but several large funnel-shaped 'sink-holes' were located on the Second peninsula, on the farms of John Young, George Acker, and Freeman Berringer, testifying to the occurrence of deposits under the heavy drift covering. As these deposits of limestone and gypsum are quite close to the Government wharf, where good shipping facilities are available, they may prove of commercial value.

Clay.

Extensive deposits of alluvial clay occur at many places along the low, swampy intervales, and glacial clay, largely made up of granite debris, is abundant on many hills. Samples of some of the more promising clays were collected for examination as to their value for brick making.

A brick-yard was in operation about 65 years ago near Lunenburg, at the Salt-pit wharf on the south shore of Back harbour. It is reported that bricks were also made by the early French settlers on Brick hill, situated on Goreham point on Second peninsula.

ARCHÆOLOGY.

Indian implements, including arrow-heads and spear-heads, flint, and pieces of earthenware, have been found on Backman beach on the north side of Second peninsula, and at other places along this part of the coast. Specimens of these are on exhibition in a small museum in the town hall at Bridgewater, and in the archæological collection of the provincial museum at Halifax.

THE CLAY AND SHALE DEPOSITS OF NOVA SCOTIA, AND PORTIONS OF NEW BRUNSWICK AND PRINCE EDWARD ISLAND.

(Heinrich Ries.)

The investigation of the shale and clay deposits in the above-mentioned region occupied the summer of 1909. The writer was assisted in the work by Mr. Joseph Keele. The object of the study was to ascertain, as far as possible, what geological formations were clay and shale-bearing, and which of these deposits were adapted to the manufacture of clay products.

With this end in view, the clay and shale deposits were examined as thoroughly as was possible, in the time at our disposal; and samples were collected for testing in the laboratory. The last was an important part of the work; since one can tell but little from the appearance of the material in the field.

The different brick plants in operation were also visited, and samples of their product taken for crushing, transverse, absorption, and freezing tests.

NOVA SCOTIA.

The geologic formations of Nova Scotia range from the Pre-Cambrian to the Triassic, and they are overlain nearly everywhere by a mantle of pleistocene material of variable thickness.

In certain formations the character of the material is such that, there is little probability of its being of any value to the clay-working industry, and these are considered first.

Formations of No Probable Value to the Clay-worker.

Pre-Cambrian.—This consists of crystalline rocks of either igneous or metamorphic character, which underlie a large portion of southwestern and southern Nova Scotia proper, and a large part of northern Cape Breton, as well as scattered areas in southeastern Cape Breton. None of the Pre-Cambrian rocks are of plastic character, nor do they become plastic when finely ground. They have no doubt been weathered to residual clays in the past; but these have probably been removed by glacial action. Only one deposit of residual material came to our attention, and this was a pocket on Coxheath mountain, near Sydney, the clay there having evidently been formed by the decomposition of a light coloured felsite, which occurs in some abundance in that region. The clay deposit is too small to be of any economic value. In recent years several attempts have been made to utilize this rock in the manufacture of firebrick, but up to the present time they have not been successful. Unfortunately some persons have promulgated the idea that, the felsite could be used by itself for brick manufacture; but this is impossible, since the material is lacking in plasticity, and could not be utilized unless some bonding material was mixed with it. If a good fireclay could be found in the neighbouring Sydney coal field, it might serve as a binder for the felsite.

It is possible that veins of feldspar or quartz, of sufficient purity and thickness to be workable, might be found in the Pre-Cambrian area, but diligent inquiry failed to discover any.

Silurian.—The rocks of this system underlie a narrow area on the south side of the Annapolis valley, and irregular areas in the eastern half of Pictou and northern half of Antigonish counties. They are economically important because of the deposits

of iron ore which they contain. Associated with these are somewhat extensive beds of shale, but most of them are rather slaty in their character, and of exceedingly doubtful value for the manufacture of clay products. On weathering they might produce plastic clays, but even so, the majority of them would be rather ferruginous. A few samples were collected for testing, in order to definitely determine their value.

Devonian.—The Devonian rocks underlie a narrow belt of irregular width extending through the central part of the Province, and underlying some small areas in southwestern Cape Breton, to the northeast and southwest of St. Peter bay, as well as on the northeastern side of the Straits of Canso, near Hastings.

These rocks were examined at a number of localities, and were found to be either too schistose in their character, or where of argillaceous nature contained too much silica, present either as disseminated sand in the shale, or interbedded sandstone layers. Were it not for the sandstone layers, the material, though siliceous, could no doubt in some cases be used for brick manufacture.

Permian.—This underlies a discontinuous area extending from Chignecto bay eastward along the north shore to a little beyond Merigomish harbour. No shales of any value were found in it.

Triassic.—The Triassic rocks form one belt following the Annapolis valley, and another one along the north shore of Cobequid bay, tapering out east of Truro. They are usually sandy in their character, and not to be looked upon as a source of either clay or shale.

Important Clay-bearing Formations.

From what has been said above, it will be seen that the formations likely to yield clay or shale deposits of value must be the lower Carboniferous, Millstone Grit, Coal Measures, and Pleistocene. These are few in number, but nevertheless they underlie areas of considerable size.

Lower Carboniferous.—Underlying, as they do, a rather extensive area in central Nova Scotia, and another one in Cape Breton, it is to be regretted that the lower Carboniferous rocks have not been more widely looked into by clay-product manufacturers. The formation is, however, somewhat variable in its character, carrying, as it does, beds of shale, conglomerate, gypsum, and limestone. Those shales closely associated with the gypsum beds may be of value for common brick manufacture, although they frequently contain considerable quantities of impurities, such as gypsum nodules, concretions of iron carbonate, or sandy streaks. At some points though, as near Pugwash, the shale occurs in large beds, and works up well to a plastic mass: the more so as it is slightly weathered. At that locality it supports one of the most active and best equipped brick plants in the Province.

Northeast of Shubenacadie, also, promising shales were found in the lower Carboniferous, while in the so-called limestone series around Sydney there were found a number of beds which appear promising for brick manufacture, provided the sandstone layers do not occur too thickly.

Millstone Grit.—This is well exposed in the area north of the Coal Measures in the Joggins district; north of the Pictou Coal Measures; south and southeast of Hawkesbury; and west and southwest of the Sydney coal field.

One cannot predict the universal distribution of promising clay or shale beds in the Millstone Grit, but small beds are not uncommon. Unfortunately, outcrops are scarce in many of the areas underlain by the rocks of this age, which increased the difficulty of finding clays or shales in it. Several deposits of fair importance were seen, and may be referred to in passing. In the Sydney region, a pit has been opened near the Steel works, exposing a bed of soft bluish shale, not less than 5 feet in thickness. A second deposit occurs near the coke oven plant of the Dominion Iron and

Steel Company, and a third one outcrops along the east shore of Sydney harbour, near Victoria Mines post-office. Although the tests of these have not yet been completed, it is highly probable that they represent a grade of material considerably higher than brick clay.

In the Pictou coal region, a rather heavy bed of mottled, shaly clay has been found northeast of Woodbourne station, on the Intercolonial railway. Preliminary tests have shown its adaptibility to the manufacture of pressed brick. It may be said here, that there is some doubt as to whether this bed lies in the Millstone Grit or Permian conglomerate, but the former view seems the more reasonable.

The Millstone Grit contains at least one shale bed of some thickness in the Joggins area; but it is probably of red burning character.

Coal Measures.—These represent the most important clay and shale-bearing formations of Nova Scotia, and were carefully examined in the several areas in which they occur. The largest is the Sydney field, of Cape Breton, and extends from the Big Bras d'Or channel to Cow bay, with only one important interruption, at Cape Percy on the northeastern shore of Cow bay, where the Millstone Grit cuts out the Coal Measures.

Owing to the almost uninterrupted line of cliffs which fringe the shore-line, a fine series of exposures was obtained. The Sydney coal field is cut into several parts by somewhat deep northeast-southwest bays; which has rendered it difficult for geologists to correlate the sections of the several subdivisions of the field. It can be said that the coal seams are interstratified with a series of shales and sandstones. These are bent into a number of gentle folds, forming the bottom of a broad trough which dips out under the sea. Throughout the field, therefore, low dips prevail. This gives the beds broad outcrops, but still the dip is sufficient to carry the bed rapidly under cover. Toward the northwestern and southeastern parts of the field the sandstone beds predominate, and the shales are of poorer quality, but in the central portion the shales are as abundant as the sandstones. The shales themselves range from smooth, fine-grained, plastic ones, of grey or red colour, to others which are quite siliceous in their character, and of doubtful value. One important deposit is found underlying a large portion of Cranberry head, near Sydney Mines. It is a smooth, greyish shale, and may prove of value for vitrified wares. In the final report it will probably be referred to as the Cranberry Head type, as it appears at a number of points. A second type found at a number of localities in the Nova Scotia Coal Measures is a somewhat soft, reddish shale, well exposed along the shore just west of Cranberry head. Not a few of the shale beds are rather siliceous in appearance and touch, and it would be unwise to express any definite opinion on them until the tests have been completed.

It seems curious that up to the present time these shales have been completely overlooked; and while it is true that they do not occur in deposits of great thickness, still they are easily accessible, and are capable of supplying a considerable quantity of raw material.

Numerous references to fireclays in the Sydney field have been published; but as far as we were able to ascertain, this region does not contain any high grade fireclays, although some of them may prove to be low grade. Unfortunately most coal miners have formed the habit of calling any 'under clay' a fireclay.

Pictou Field.—In this field there are numerous shale beds associated with the coal seams, but they are best developed in the central portion of the area, and the most important known up to the present time are higher up in the section than the coal beds. Many of these shales when ground and mixed with water are of strong plasticity, but they unfortunately contain such a high percentage of carbonaceous matter as to require great care in burning, and some of the shale beds are too high in carbonaceous or petroliferous matter to be used at all; while others have to be avoided

on account of the abundant siderite concretions; but in spite of these disadvantages, the field is an important holder of commercially valuable shale deposits. In some parts of the section, as along Coal creek, south of the Allan shaft at Stellarton, the beds of shale are occasionally quite free from carbonaceous material. In only one instance is an under clay worked, viz., at the Drummond colliery at Westville, where a hard shale is mined for the manufacture of bricks. The most important utilization of the shales is near New Glasgow, where they are made into common and pressed brick, flue linings, sewer pipe, and drain tile. Pleistocene drift clay is sometimes added to the pipe mixture.

Inverness Field.—This small field carries a number of shale beds associated with the coals, but few of them are of great thickness; indeed, none of them are equal in volume to those worked in the Pictou area. A good bed outcrops on the shore a few hundred feet south of the dock, and a plastic shale is said to underlie the 7 ft. coal. Most important, however, is the bed of grey, plastic clay which overlies the 13 ft. seam, and is found at several points where that seam is cut through by streams. It is, probably, a No. 2 fireclay, and varies in thickness from 18 inches to 3 feet. If the tests prove it to be of refractory character, it would be practicable to work it in connexion with the coal.

Port Hood Field.—Here, too, there are scattered shale occurrences in both the Millstone Grit and Coal Measures; but the most important is along the shore a short distance north of Judique harbour, where a bluish-grey shale, with a vertical dip, and about 8 to 10 feet thick, outcrops for some distance along the shore.

Joggins Area.—This field contains a number of thin shale seams interstratified with sandstone in the Coal Measure rocks, but few of them are of any thickness. The most important, perhaps, is south of McIntyre brook; while a second one, of possible value, underlies the coal seam at Joggins.

Pleistocene Clays.—These may be roughly divided into two classes: (1) glacial clays, usually of stony character, but very plastic, tough, and red burning; and (2) marine clays, often strongly laminated, but also quite plastic and red burning. These two types of clay are rarely used for anything but drain tile and common brick. A few pressed brick are made from them, and the smoother ones could be utilized for the manufacture of common ornamental terra-cotta and cheap art pottery. The marine clays are best developed in the Annapolis and Shubenacadie valleys, while the stony, glacial clays are worked mainly in the Cape Breton region.

A most remarkable clay, and one of undetermined age, is that found at Shubenacadie and in the Musquodoboit valley. The material is a highly plastic clay, of dark grey, white, or mottled red and white colour, lying beneath the glacial drift, and resting, possibly, on bed-rock. Its thickness, as indicated by a series of borings made by Mr. Keele, ranges from 7 to probably 50 feet. Scattered lumps of lignite were found in the clay at Shubenacadie, and it is hoped that the age of these can be determined.

It is exceedingly difficult to determine the exact area underlain by this deposit, owing to the heavy mantle of glacial drift covering the region; but the fact that the material is found at several points extending over a distance of 7 miles, indicates its probable extent, unless some of the masses have been pushed along with the drift. Borings could, of course, only be made at those points where the drift cover was thin or absent.

The clay burns to a cream colour, and fairly dense body at a comparatively low temperature. It is at least semi-refractory in its character, and may prove to be a stoneware clay. Some test bricks were made from a carload lot of this clay, taken from a shaft sunk in the deposit at Shubenacadie.

It is safe to say that nothing like it has been found elsewhere in Nova Scotia, and its resemblance to some of the Cretaceous fireclays of New Jersey is striking.

NEW BRUNSWICK.

As most of our time was required for the examination of the Nova Scotia clays, but little of the field season was left for New Brunswick. Several localities were examined, and the following is a condensed statement of the results.

In the vicinity of Albert Mines, in Albert county, there are some very promising beds of Devonian shales, which are probably of red burning character. In the event of the oil-shales at that locality being developed, these shales will be of importance for brick manufacture, but aside from this, they may prove to be of value for making pressed brick to be shipped to other markets. Nearby there are also red burning shales of lower Carboniferous age. Some of the latter are located along the line of the railway.

Many shale deposits, some of which may prove to be of refractory character, are associated with the coal deposits around Minto and Chapman, northeast of Grand lake. Similar shales underlie and overlie the coal 12 miles southeast of Harcourt.

Marine clays are worked for common, and some pressed brick, at both St. John and Fredericton.

PRINCE EDWARD ISLAND.

The only clay resources of Prince Edward Island are of Pleistocene age. Common brick clays are found at a number of points, but are worked to but a slight extent.

CLAY WORKING INDUSTRY.

Up to the present time, the clay deposits of Nova Scotia have been but little developed. Common brick are made at Annapolis, Middleton, and Avonport in the Annapolis Valley region, and at Shubenacadie, and Elmsdale in the Shubenacadie valley. Other yards are in operation at Sylvester, New Glasgow, Pugwash, Eden Siding, and Mira River. In most cases these are operated to supply a rather local demand, although the Annapolis and Pugwash brick are sometimes shipped some distance by water. Common pottery is made from the smoother sections of the surface clays south of Elmsdale. Most of the common brick yards re-press a few brick. A hard brick, known in the trade as a firebrick, but not really such, is made from the Carboniferous shales at Westville. Sewer pipe, flue linings, and drain tile are made from the shales at New Glasgow; and some drain tile are manufactured in the Annapolis valley by the same firms that produce brick.

It will be seen, therefore, that there is considerable room for expansion. If such development occurs, the markets will be mainly outside of the Province; except for common brick. At present the buildings in that region are constructed mainly of wood; but as the supply of this becomes scarcer and more expensive, brick must be utilized as a substitute. For outside markets, the plants should be located as near to water as possible, to avoid rail shipment.

It is hoped thaat the studies of the samples now being carried on will demonstrate the value of the clay and shales for making pressed brick, vitrified brick, earthenware, and perhaps stoneware, sewer pipe, etc.

CLAYS AND SHALES IN THE MARITIME PROVINCES.

(Joseph Keele.)

Having received instructions to assist Dr. Heinrich Ries in an examination of the clays and shales of the Maritime Provinces, I left Ottawa on June 15, and proceeded to that region. After reaching the field, a few days were spent in company with Messrs. Ells and Fletcher, familiarizing myself with the stratigraphy of certain of the rock formations in which beds of shales are most abundant. On June 25, I joined Dr. Ries at Halifax, and we went to the Sydney coal field; from which point we had decided to begin the season's work.

The work consisted of prospecting for clays and shales suitable for use in the various branches of the clay industry; and in visiting the localities where these materials are already known to occur.

About 100 samples were collected from different localities; and shipped to Ottawa, for examination, and subjection to the usual series of tests, with a view of determining their utility.

In order that the samples should represent the average value of each deposit, the following method of collecting was adopted. When a bed of shale or clay was found which appeared to be of economic importance, and had a scarped face, a trench, deep enough to reach below the weathered surface, was dug completely across the face, at right angles to the bedding. The fresh material thus exposed was then broken down, and about 60 pounds taken as a sample.

The thickness of the deposit; the ease with which it might be mined; and its situation with regard to fuel, manufacturing, and transportation, were also considered in estimating the economic value of an occurrence.

Small samples of a few pounds' weight were taken from beds or deposits of less importance, or in certain cases to supplement the large samples taken from important deposits.

A light boring apparatus, consisting of a set of 1¼ inch augurs, which could be attached to about 30 feet of jointed piping, was used for testing deposits of surface clays where no face was exposed. A core could be drawn with this instrument, giving a complete section deep enough to prove the value of a deposit.

The greater part of the season was spent in company with Dr. Ries on the areas referred to in his report; but several journeys were made by the writer alone to other areas where clays and shales were known to occur. The localities visited were: River Denys, Guysborough, Arisaig, and Parrsboro, in Nova Scotia; also Albert Mines, and the Grand Lake coal area in New Brunswick. The Grand Lake area appears to be the most important of these localities, since there, an abundance of plastic shales—which may prove useful in the manufacture of brick and tile—occur in the Coal Measures. In mining the coal in this district, it is necessary to remove about 3 feet in thickness of accompanying shale, and great heaps of this material lie weathering on the surface at the different mines.

The principal mining operations are carried on at the village of Minto: the terminus of the New Brunswick Central railway.

A mine opened this summer near the shore of Salmon bay—about 7 miles east of Minto—has a good bed of underclay, which could be easily worked in connexion with the coal. The construction of the new Transcontinental railway through this region has revealed a very promising bed of plastic shale, at least 5 feet thick, lying close to the surface, at Chipman station, about 15 miles east of Minto.

After the departure of Dr. Ries from the field, the writer was directed to make borings on some important clay deposits situated in the valley of the Musquodoboit river, and at Shubenacadie in the Province of Nova Scotia. About two weeks were spent at this work, and a great deal of information was obtained regarding the extent and character of these clays, which will be more fully described in the final report.

The clay in the Musquodoboit valley underlies glacial drift; but is exposed at several points along the river, and on some of the brooks which have cut down to it through the overlying drift. The deposit is extensive, and may be traced for a distance of 7 miles along the valley; its width is unknown.

The borings at Middle Musquodoboit afforded a section of, at least, 50 feet; clays, silts, and sands with fragments of lignite. The beds are irregular both in vertical and lateral directions, and the prevailing colour of the clay is a mottled red and grey; but there are several beds of both light and dark grey colour, without any admixture of red. It is said by some pottery manufacturers who have examined it, to be a good stoneware clay; but whatever value in the clay industries the tests now being made may indicate, it is not commercially available at the present time, as it is situated about 15 miles from the nearest railway.

The deposit at Shubenacadie is crossed by the main line of the Intercolonial railway, and has been worked to a limited extent in the manufacture of stoneware. The clay is mined at present from a shaft sunk about 50 feet east of the railway track, and about a quarter of a mile south of the railway station. About 20 feet of drift overlies the clay at this point, the workable bed being about 10 feet thick. A boring at the bottom of this shaft showed 16 feet of grey silty clay. This was as deep as could be penetrated.

The upper surface of this underlying clay is also undulating, and does not conform to the present land surface; for at a distance of 200 feet north of the shaft the clay is found at less than a foot below the surface; the intervening ground being level. On the west side of the railway the ground rises slightly, and opposite the shaft, the clay was found to be from 9 to 13 feet below the surface.

In an endeavour to trace the extent of the deposit, a number of borings were made around the village of Shubenacadie; but most of these did not reach the clay, owing to boulders in the drift covering. Borings for water show that the deposit underlies most of the ground occupied by the village; but the amount of overburden is at most points too great to permit of it being worked. The colour of the clay is almost uniformly lead-grey; but it bleaches to a light grey or dirty white on exposure to the atmosphere, and there is no red colour present. The beds show the same alternation of clays, sands, and silts as those in the Musquodoboit region; but there appears to be more lignite present in the Shubenacadie deposit.

These deposits are of great geological interest: for, as far as we are aware, there are no similar ones anywhere else in eastern Canada. Dr. Ries has suggested a possible correlation for them in his report.

WATER AND BORINGS BRANCH.

(Elfric D. Ingall.)

The routine of collecting the geological data, rendered available through borings made throughout the country, has been prosecuted throughout the year. It is regretable, however, to have to report that the response on the part of operators has not been what it should have been.

Apart from the collection of this new material, progress has been made in assembling and compiling information relating to the subjects dealt with in the prosecution of the work, from a wide range of literature descriptive of the geological formations of Canada and related portions of the United States.

The intelligent prosecution of any boring, whether made in search of water, gas, oil, salt, coal, or any other substance exploitable by this means, calls for very varied information; not only as to local details of the geological column to be bored through, but as to the broader geological conditions of the region.

It is also of importance that information should be available as to the difficulties encountered during the progress of previous borings made in the district, and as to the indications then encountered of the presence or absence of useful mineral substances.

Account must be taken of the experience gained elsewhere in apparently similar formations and under like conditions, also of the probable causes operating in the origination and distribution of workable bodies of the minerals sought.

In order to aid the drillers in the planning of their ventures, it is necessary to compare and correlate the information so that it can be rendered available. This will involve the Branch in an undertaking which will consume much time apart from that necessarily absorbed in the routine of collecting fresh boring records and samples of drillings; recording, filing, and studying them, and the preparation of this material for publication. In view, then, of the small means at command compared to the necessary extent of the work, and of the manifest benefit to accrue to the drillers and others interested, a strong plea is again made for the hearty and prompt co-operation of all those engaged in this line of business.

A slight consideration of the subject will surely bring conviction of the great utility of a central office, which will record, compile, and interpret all boring records, and thus render available the general conclusions to be drawn from such a mass of data. It will be evident, also, that this can be done without publishing the records received from any operators who desire to keep their results confidential.

During the greater part of the year, J. A. Robert acted as assistant, helping very materially in the inauguration of the system for filing and recording the records and drillings received, and in the classification of data relating to borings, etc., scattered throughout the official literature, as well as in other ways.

SECTION OF MINERALOGY.

(Robt. A. A. Johnston.)

The work in the mineralogical section has been of the same general character as that of last year. There has been a marked increase in the number of inquiries of a technical character regarding Canadian minerals. These, in the main, have been made personally, and no record was kept of them; the replies to them, however, have taken up a great deal of time. Over 600 specimens have been received, examined, and reported upon.

The Educational Collections have, as heretofore, received careful attention, in order to maintain the standard to which they have been brought. In the case of one or two varieties used in these collections, we have been disappointed in securing supplies. It is hoped, however, that this difficulty will be soon overcome, and that the omissions from collections sent out last year may be filled. There have been frequent inquiries for a collection suited to the needs of the Continuation Classes of the public schools, and other classes of the same general character. To meet these requirements, a new collection has been arranged, to be known as Grade 2: and consists of 32 of the more common minerals, and 12 of the more common rocks. For this collection a new case has been designed. A number of these have been distributed, and are meeting with a good deal of approval amongst teachers.

Very considerable additions have been made to the Museum collection, as will be seen from the accompanying lists. Much of the credit for these is due to the efforts of Mr. R. L. Broadbent, who, in February last, was entrusted with the duty of making a collection of minerals from British Columbia and Yukon, for the Alaska-Yukon-Pacific Exposition at Seattle, Washington, U.S.A. These specimens are now the property of the Museum, and are being stored, pending the completion of the Victoria Memorial Museum building. Mr. Broadbent's report will be found appended hereto. The list of specimens collected by him in this connexion is given separately; for the reason that it seemed desirable to make a more easily available record of it than could otherwise be made. Previous to his departure for British Columbia in February, he was engaged in the general work of recording and labelling specimens for the Museum.

Some important additions have also been made to the collection of foreign minerals, mainly through the medium of exchanges. This collection is becoming increasingly useful in directing the efforts of prospectors and others in their search for economic minerals.

Mr. A. T. McKinnon has continued to render faithful and efficient service in collecting and preparing material for the Educational Collections. The packing and shipping of these collections has also been superintended by him. Between June 5, and October 5, he was engaged in collecting materials at various localities in the Provinces of Ontario, Quebec, New Brunswick, and Nova Scotia, during which time he secured over 14 tons of selected material for use in the collections.

Acknowledgments are due to the following gentlemen for much kindly advice in respect of localities, and in many instances for free contributions of material: Mr. M. J. O'Brien, Renfrew, Ont.; Mr. J. J. Fowler, Ottawa, Ont.; Mr. Bush Winning, Ottawa, Ont.; Dr. F. D. Adams, Montreal, Que.; Mr. John Cherry, Perth, Ont.; Mr. Wilson Bailey, and Capt. Wallbridge, Madoc, Ont.; Mr. Andrew Hamilton, Lascelles, Que.; Mr. S. J. McMeekin, Ottawa, Ont.; Mr. Chas. J. O'Connor, Long Point, Ont.; Mr. Wm. Stephens, Tennycape, N.S.; Mr. John Higson, Stellarton, N.S.; Mr. M. B. Spears, Pusey, Ont.; Mr. Ezra Churchill, Walton, N.S.; Mr. C. Noble Crowe, Lake George, N.B.; Mr. Harry Piers, Halifax, N.S.

Collections were distributed during the year, as follows:—

Provinces.	Standard Collections.	
	Grade 1.	Grade 2.
Alberta	4	
British Columbia	2	
Manitoba	5	
New Brunswick	6	4
Nova Scotia	8	
Ontario	53	6
Quebec	43	1
Saskatchewan	5	
	126	11
To foreign institutions		2

Special collections totalled 1,152 specimens.

Mineral chips, in sets of about 45 different kinds, were distributed, as follows:—

Province.	
New Brunswick	2
Quebec	1

The following additions have been made to the Museum collection.

DONATIONS.

Mr. A. L. Ogilvie, Ottawa, Ont.:—

Silver ore, from the Lucky Godfrey mine, township of Willet, Nipissing district, Ontario.

T. L. Willson, Ottawa, Ont.:—

A series of electro-metallurgical products.

Mr. John J. Caley, North Bay, Ont.:—

Calc sinter, from Trout lake, 20 miles north of Nemego station, Algoma district, Ontario.

Capt. Gilchrist, Ottawa, Ont.:—

Asbestos, Bell Asbestos mine, Thetford, Que.

Mrs. Angeline Lafrance, Montcerf, Que.:—

Infusorial earth, Montcerf, Ottawa county, Que.

Mr. Thos. Morrison, Bancroft, Ont.:—

Two slabs of marble from Bancroft Marble quarries, Dungannon township, Hastings county, Ont.

Mr. Wm. Mulligan, Sand Point, Ont.:—

Green diopside, Fitzroy township, Carleton county, Ont.

Mr. J. B. Black, Windsor, N.S.:—
Mountain leather, West Colchester, N.S.; partially inspissated bitumen, East Hants, N.S.

Rev. J. A. Mauseau, St. Felix de Kingsey, Que.:—
Broken crystals of white translucent quartz, from lot 8, range III, Kingsey township, Drummond county, Que.

Mr. W. C. Hamilton, the Leitch Collieries, Passburg, Alta.:—
Inspissated bitumen in calcite, from section 6, township 7, range 2, west of the 5th meridian.

Mr. R. H. Stewart, Moyie, B.C., per R. L. Broadbent:—
Pyromorphite, from the Society Girl claim, Moyie, East Kootenay, B.C.

Mr. F. Soues, Clinton, B.C.:—
Native arsenic with a little realgar in crystalline dolomite, from Watson Bar creek, Fraser river, B.C.; mispickel in quartz, Watson Bar creek, Fraser river, B.C.

Lake Copper Mining Company, New Glasgow, N.S., per R. W. Ells:—
Copper ore (chalcopyrite and pyrite with ankerite), from the Polson Lake mine, Antigonish county, N.S.

Mr. A. Gracey, Nelson, B.C., per R. L. Broadbent:—
Scheelite and tungstite in quartz, Kootenay Belle mine, Nelson Mining division, B.C.

Mr. Ivan A. Bayley, Sydney Mines, C.B., N.S.:—
Mountain leather, from Lower Five Islands, Colchester county, N.S.

Mr. R. L. Clarke, per J. A. Dresser:—
Pyrite and chalcopyrite, from Weedon, Wolfe county, Que.

Hon. H. R. Emmerson, per H. M. Ami:—
Sixteen samples of crude petroleum, from wells at St. Joseph, Westmorland county, N.B.; thirteen samples of crude petroleum, from wells at Dover, Westmorland county, N.B.

Mr. Thos. Watt. Pozerville, Alta.:—
Thenardite, Pozerville, Alta.

Carborundum Company, Niagara Falls, N.Y.:—
Crystallized silicon.

Mr. Bush Winning, Ottawa, Ont.:—
Hematite in thin films assuming the crystal outline of the enclosing muscovite, Villeneuve mica mine, lot 31, range I., Villeneuve township, Labelle county, Que.

Mr. C. J. Lutes, Tisdale, Sask.:—
Calcareous tufa, Tisdale, Sask.

Mr. Thos. Burgess, Ottawa, Ont.:—
Tennantite in dolomite, Breen's farm, near Bulger post-office, Renfrew county, Ont.

Mr. W. T. Mason, Montreal, Que., per H. M. Ami:—
Gold ore, from the Dr. Reddick claim, Larder lake.

Mr. Louis O. Hedlund, Hedley, B.C.:—
Specularite in quartz, Hixon creek, Cariboo district, B.C.

COLLECTED BY OFFICERS OF THE DEPARTMENT OF MINES.

Mr. R. W. Brock:—
Gold ore, from Poorman mine, Nelson, B.C.; native copper, from south end of Atlin lake, B.C.; copper ore, from the Stewart group of claims, Portland canal, B.C.; copper ore, from the Bear River camp, Portland canal, B.C.; copper ore, from the Swede group of claims, Lockeport, Queen Charlotte islands, B.C.; copper ore from the Klondike river, some miles above Hunker creek, Yukon.

Mr. A. M. Campbell, Ottawa:—
Specimen of scheelite in quartz from Waverley, Halifax county, N.S.

Mr. D. B. Dowling:—
Coal, from the 4 ft. seam on the Kneehill Coal Company's property, Carbon, Alta.; coal, from the Russel claim at the head of McLeod river, Alta.; lignite, from the Potter mine, southwest of Banff on the north bank of Battle river, Alta.; five samples of coal, from the Brazeau river, Alta.; coal, from the Pacific Pass Coal Company's property, Little Pembina river, Alta.; coal, from the Saskatchewan and Alberta collieries, Grassy lake, Alta.

Mr. E. R. Faribault:—
Scheelite, from the Reynolds and McCallum veins, Moose river, Halifax county, N.S.

Mr. B. F. Haanel:—
Massive ilmenite with implanted crystals of the same mineral, from the township of Ham, Wolfe county, Que.

Dr. Eugene Haanel:—
Iron ore concentrates and briquettes, from the Coehill mine, Hastings county; Calabogie, Renfrew county; Timagami, Nipissing district; and Moose mountain, Algoma district, in the Province of Ontario.

Mr. Joseph Keele:—
Clay, Mira brickyard, Cape Breton county, N.S.; shale, coast near Barachois harbour, south of Low point, Cape Breton county, N.S.; shale, between coal seams on coast near Low point, Cape Breton county, N.S.; fireclay (so-called), Fraser's quarry, Coxheath, Cape Breton county, N.S.; shale, Coal Measures, Brooks brickyard, New Glasgow, Pictou county, N.S.; shale, New Glasgow, Pictou county, N.S.; fireclay, Drummond colliery, Westville, Pictou county, N.S.; clay, Smalls brook, near Woodlawn station, Pictou county, N.S.; clay, Miller's brickyard, Eden Siding, Cape Breton county, N.S.; clay (with baddeckite), Baddeck, Victoria county, N.S.; fireclay, dark band in, Shubenacadie, Hants county, N.S.; clay, Shubenacadie, Hants county, N.S.; clay, Miller's brickyard, Shubenacadie, Hants county, N.S.; clay, Musquodoboit river at Middle Musquodoboit, Halifax county, N.S.; clay, Murphy brook, Middle Mus-

quodoboit, Halifax county, N.S.; clay, Diogenes brook, Denys river, Inverness county, N.S.; clay, West river, Antigonish county, N.S.; clay, from above coal seam, McLellan brook, Inverness county, N.S.; clay, from Coal Measures at Hussey Drift, Inverness county, N.S.; clay shale, Port Hood, Inverness county, N.S.; clay, Shaw's brickyard, Middleton, Antigonish county, N.S.; clay, with sandy partings, Shaw's brickyard, Antigonish county, N.S.; clay, Annapolis brickyard, Annapolis county, N.S.; clay, Joggins main seam, Joggins Mines, Cumberland county, N.S.; shale, Pugwash, Cumberland county, N.S.; clay, Moncton, Westmorland county, N.S.; shales overlying oil-shales, south branch of Frederic brook, Albert Mines, Albert county, N.B.; red shales, Weldon brook, Albert Mines, Albert county, N.B.; clay, Lee's brickyard, St. John, N.B.; clay, Mooney's brickyard, St. John, N.B.; shale overlying coal, Grand Lake coal basin, Queens county, N.B.; shale, Pipe-line trench, National Transcontinental railway at Chipman station, Queens county, N.B.; clay, Miller's brickyard, Elmsdale, Hants county, N.S.; clay, Enfield Pottery, Enfield, Hants county, N.S.; ornamental tile, Hornby brickyard, Charlottetown, P.E.I.; firebrick, from clay at Shubenacadie, Hants county, N.S.; firebrick, from underclay at Shubenacadie, N.S.; silica-brick, made by the International Coal Mining Company at Westville, Pictou county, N.S.; stiff mud brick, Maritime Clay Works, Pugwash, Cumberland county, N.S.; stiff mud brick, Miller's brickyard, Shubenacadie, Hants county, N.S.; soft mud brick, Middleton Clay Working Company, Middleton, Annapolis county, N.S.; soft mud brick, underburned, Shaw's brickyard, Avonport, Kings county, N.S.; soft mud brick, well burned, Shaw's brickyard, Avonport, Kings county, N.S.; green brick, underburned, Shaw's brickyard, Avonport, Kings county, N.S.; stiff mud brick, The Buckler Brick Company, Annapolis, N.S.; stiff mud brick, John Lee & Company's brickyard, St. John, N.B.; stiff mud brick, re-pressed, John Lee & Company's brickyard, St. John, N.B.; soft mud brick, Mira Brick Company, Mira river, Cape Breton county, N.S.; brick, M. Ryan & Son, Fredericton, N.B.

Mr. W. W. Leach:—

Three samples of coal, from points near the head of the Skeena river, British Columbia; a series of gold and silver ores, from the Skeena River Mining division, Cassiar district, British Columbia.

Mr. O. E. Le Roy:—

Crystals of calcite, from the Granby mines, Phœnix, B.C.

Mr. R. G. McConnell:—

Nugget of native copper, Burwash creek, Yukon; limestone, from Texada island, B.C.

Mr. A. T. McKinnon:—

Tetrahedrite in fluorite, from lot 1, concession IV, township of Madoc, Hastings county, Ont.; fluorite with incrustation of barite, from the same locality; celestite, from lot 2, concession VIII, township of Lansdowne, Leeds county, Ont.; agate, from Partridge island, Cumberland county, N.S.; calcite, from Five Islands, Cumberland county, N.S.; marble, from the township of Faraday, Hastings county, Ont.; quartz, muscovite, and uraninite, from the Villeneuve mine, township of Villeneuve, Labelle county, Que.; albertite, from Albert Mines, Albert county,

N.B.; molybdenite and molybdite, from the township of Egan, Ottawa county, Que.; diopside, from the township of Cardiff, Haliburton county, Ont.; albite, from the township of Wicklow, Hastings county, Ont.; blue calcite, from the township of Lynedoch, Renfrew county, Ont.; staurolite, from Pubnico, Yarmouth county, N.S.; damourite and fluorite, pseudomorph after tourmaline, from the Villeneuve mica mine, township of Villeneuve, Ottawa county, Quebec; pentlandite, from the Krean Hill mine, township of Denison, Nipissing district, Ont.

Mr. W. J. Wilson:—

Contorted crystals of apatite, from Carp, Carleton county, Ont.

Mr. M. E. Wilson:—

Auriferous quartz, from the Kerr-Addison mine—claim H.S. 165—Larder lake, Nipissing district, Ont.

PURCHASES.

Gold nugget, from Slate creek, Dease river, Cassiar district, B.C.

The 'Big Skookum' meteorite.—This meteorite was uncovered at a depth of 65 feet in the gold-bearing gravels on claim No. 7, Big Skookum gulch, Bonanza creek, Yukon, by Mr. W. Kast, on January 21, 1905. It was exhibited at the Alaska-Yukon-Pacific Exposition at Seattle, Washington, U.S.A., where it was secured by Mr. R. L. Broadbent.

In form it is, roughly speaking, a block varying in thickness from 3 to 8 centimetres, and exhibiting an irregular pentagonal outline; it measures 29 centimetres in length by 23 in width, and weighs 15·88 kilogrammes. The skin is well preserved, is smooth and somewhat glossy, and has a brownish-black colour. The specimen is exteriorly characterized by a number of broad and shallow depressions: one of which has a breadth of 21 centimetres, with a maximum depth of 2 centimetres. In some instances these depressions give to the edges of the specimen a more or less crescentic form; and they are further marked by abundant small pittings or pesographs. The classification of this meteorite is as yet unknown, as it has not been cut into, much less examined internally. By kind permission of Dr. James Bonar, the Deputy Master, there has been executed at the Royal Mint, under the superintendence of Mr. A. H. W. Cleave, a very fine model in metal, which has also been added to the Museum collection.

The following additions have been made to the collection of foreign minerals.

DONATIONS.

Messrs. Powers, Weightman, and Rosengarten, Philadelphia, Pa., U.S.A.:—

Epsomite, from the vicinity of Oroville, Washington, U.S.A.

Mr. L. C. Morganroth, Pittsburgh, Pa., U.S.A.:—

Magnesite, from Hungary.

EXCHANGES.

Mr. W. A. Franks, Gunnison, Colorado, U.S.A.:—

Carnotite and roscoelite, from Telluride, Colorado; rubellite with lepidolite, from San Diego, California; sphalerite, from Joplin, Mo.; malachite, from Uinta, Utah; stephanite with malachite and horn silver, from Pilkin, Colorado; scoria and pale amazonite, from Gunnison, Colorado; lepidolite, from Cañon City, Colorado; native tellurium, from Vulcan,

Colorado; zircon, from Cache, Oklahoma; bornite, from Bisbee, Arizona; copper ore, from the Copper Queen mine, Douglas, Arizona; tourmaline in mica, from Parkesburg, Colorado.

South Australian School of Mines and Industries, Adelaide, South Australia:—

Vanadic ochre, from Leigh creek, South Australia; crocodite, from Hawker, South Australia; ullmannite, from Gilles Bluff, Mount Lyndhurst, South Australia; carnotite, from Olary, South Australia; atacamite, from Mutooroo mine, South Australia; blue corundum in mica schist, from Mount Paynter, South Australia; magnesite, from Osmond mine, Gilles Glen, South Australia.

Rhodesia Museum, Buluwayo, Rhodesia:—

Chrysotile, from Shashi river, Victoria, Mashonaland; muscovite, from Selukwe, Rhodesia; microcline, from Selukwe, Rhodesia; barytes, from Kwekwe river, near Gwelo, Rhodesia; semi-opal, from Buluwayo; epidote in aplite, from Buluwayo; scheelite, from King mine, Umswezwe, Rhodesia; amethyst, from Syringa, Rhodesia; wolfram, from Essexvale, Rhodesia; auriferous pyrites, from Valley mine, Gwanda; chalcedony, from Charter, Mashonaland; yellow ground, from Bembezi Diamond Pipes; tourmaline in quartz, from Salisbury, Rhodesia; mispickel, from Victoria, Rhodesia; stibnite, from Gatuma, Rhodesia; molybdenite in quartz, from Gadzema, Rhodesia; auriferous copper-pyrites, from Valley mine, Gwanda; vanadite on bone breccia, from Broken Hill mine, Northwest Rhodesia; agate, from Charter, Mashonaland; copper-bearing sandstone, from Kasempa, Northwest Rhodesia; chrysocolla, from Northwest Rhodesia; granular chromite, from Selukwe, Rhodesia; siliceous sinter, from the Zongala geyser, Sibungwe, Rhodesia; compact chromite, from Selukwe, Rhodesia; auriferous irridescent limonite, from the Falcon mine, Charter, Mashonaland; gold in quartz, from the Gulong mine, Gwanda; diamond-bearing wash, from Somabula; limonite, pseudomorph after pyrite, from Bembezi; cassiterite in decomposed granite, from the Bushwell mine, Transvaal; auriferous chlorite, from the Bell mine, Kwekwe; stream tin, from Bussanga, Congo Free State.

REPORT OF SPECIAL COLLECTIONS MADE FOR THE ALASKA-YUKON-PACIFIC EXPOSITION, SEATTLE, WASHINGTON, U.S.A., JUNE-OCTOBER, 1909.

(R. L. Broadbent.)

In February, 1909, I received instructions from the Director of the Geological Survey to proceed to the Province of British Columbia for the purpose of collecting and preparing a representative series of the minerals of the Province for display at the Alaska-Yukon-Pacific Exposition at Seattle, Washington, U.S.A. I was also instructed to remain in charge of the exhibit during the Exposition.

In accordance with these instructions, I left Ottawa on February 15; and between this date and May 8, all the more important mining districts of the Province were visited. In connexion with my duties, I was accorded the hearty co-operation of the Provincial Department of Mines, the various Boards of Trade, and the mine and smelter managers; while Mr. G. O. Buchanan of Kaslo was at particular pains to secure a very fine exhibit from the Nelson, Slocan, and Ainsworth Mining divisions. The installation of the exhibit was completed in time for the opening day of the Exposition, and I remained in charge of the Canadian Mineral Section until the close, returning to Ottawa on November 13.

The Canadian Mineral Section occupied an area of 18,000 square feet; 10,000 square feet of which was devoted to the exhibits from British Columbia. With the exception of the structural materials, everything was shown under glass: a method by which the specimens were kept uniformly bright and clean during the whole course of the Exposition.

The extensive and varied exhibits of ores and minerals from British Columbia, together with those of smelter products made by the Tyee, Granby, B.C., and Trail Smelting Companies, naturally attracted a great deal of attention. The display made in connexion with the latter Company's exhibit was very attractive, and included specimens of the ore as taken from the mine; the concentrates made therefrom; as well as different products obtained in successive smelting operations up to and including pig-metal, bullion, etc. Large specimens of ore from the Centre Star, War Eagle, and other mines of the Boundary district, also from the St. Eugene mine, Moyie, East Kootenay, were shown by this Company. The exhibit from the last mentioned locality embraced two specimens of silver-lead ore, weighing over a ton each.

The Marble Bay mines, Texada island, were represented by a very interesting series: which embraced some fine examples of bornite with native silver taken from the 960 ft. level—910 feet below sea-level.

A fine collection of the auriferous ores and associated rocks and minerals of the Nickel Plate mine, Hedley, B.C., together with a plan showing a section of the ore-body, and a plan of the Reduction mill, was furnished by Mr. M. K. Rodgers of Seattle, who has since presented it to the Museum.

In addition to the foregoing, the following mines in British Columbia were also represented: Bluebell, Arlington, Ruth, and Emerald claims in the Kootenay district—by large specimens of silver-lead ores; the Mollie Hughes, Krao, Elkhorn, Prince Henry, and Jewel claims of the Boundary district—by ores carrying native silver; the Ikeda Bay mines, Queen Charlotte islands, and the Hidden Creek mine, Observatory inlet, Portland canal—also by ores containing native silver; and a number of claims in the Queen Charlotte, Atlin, and Skeena River Mining divisions—by copper-gold and silver-lead ores.

Amongst the exhibits of metalliferous ores and their products, there was an extensive collection from the districts about Cobalt and Sudbury, in the Province of Ontario: this included rich silver ores from the former district, and copper and nickel ores from the latter; while displays of the metallurgical products of these ores—complete in every detail—as prepared by the Canadian Copper Company, and the Mond Nickel Company, added further interest to the exhibit.

Over $10,000 worth of native gold was shown in four table cases. This exhibit included a very fine collection of British Columbia gold nuggets, secured by the Dominion Assay Office at Vancouver; gold dust and nuggets from Yukon; and gold-bearing quartz from Nova Scotia.

The asbestos industries of the Eastern townships of the Province of Quebec were represented by an extensive display, which attracted particular attention from the general public. The modes of occurrence of this mineral were clearly shown in a number of large blocks, which were the subject of frequent inquiry on the part of visitors.

The mica industries were well represented by a series of specimens from Ontario and Quebec, together with a fine collection of finished products made from like materials.

The display of British Columbia marbles in this section indicated a marked advance in this industry in the Province, and included some very handsome polished specimens from Nootka Marble quarries, Nootka sound, west coast of Vancouver island, and from the Marblehead quarries, Marblehead and Gillett's quarry, Kootenay lake, West Kootenay.

In the division devoted to coals, all the principal British Columbia fields were represented. These were uniformly arranged in pyramids, 4′-6″ high. The names of the mines represented will be found at the end of the accompanying list.

The Electric Reduction Company of Buckingham, Quebec, furnished a fine exhibit of ferro-chrome, ferro-silicon, and ferro-phosphorus.

The Mines Branch of the Department of Mines, Ottawa, furnished an interesting exhibit, illustrating the reduction of iron from its ores by the electro-thermic process.

An exhibit of fireclay and its products, from the works at Clayburn, B.C., was made by the Vancouver Fireclay Company, and was very favourably commented upon. There was also an exhibit of cupels and magnesite-brick for electric furnaces, prepared from the magnesite of Atlin, B.C.

The total attendance at the Exposition was 3,740,551.

The following is a list of the specimens collected in the Province of British Columbia:—

Ores and Minerals of British Columbia.

ORES FROM ATLIN, B.C.

Native copper—Torres channel. Wm. C. S. Hathorn.
Auriferous quartz—Imperial mines.
Auriferous quartz—Engineer mine.
Cobalt bloom (erythrite)—Pat. Gallagher.
Galena, blende, and pyrite—Wm. C. S. Hathorn.
Chalcopyrite—Lavardiere Bros.
Bornite, and chalcopyrite—Lavardiere Bros.
Blende, and galena—Taku Arm. J. Dunham.
Galena, and chalcopyrite—Atlin. Capt. Alexander.
Azurite, and malachite—Robert Grant.
Galena (argentiferous)—Big Cañon group.
Fourth of July creek—Tom Vaughan.
Native copper—Atlin. Lavardiere Bros.
Chalcopyrite—Atlin. Lavardiere Bros.
Galena—Norman Fisher.
Tetrahedrite—Lavardiere Bros.
Gold and silver ore—Boulder mountain. W. C. S. Hathorn.
Chalcopyrite—Juan river. Ben Nichols.
Stibnite (antimony ore)—Atlin. J. Fox.
Galena with chalcopyrite—Brown group.
Gold-copper ore—Taku Arm. Thos. Kirkland.
Nickel ore—Spruce mountain. Major Neville.
Auriferous quartz—Atlin. Wm. Gass.
Auriferous quartz—Boulder mountain.
Auriferous quartz—Juan river. Larry O'Connor.
Magnetite with chalcopyrite—Atlin.
Auriferous quartz—Boulder mountain. Jas. Clarke.

Coal—vicinity of Atlin.

Magnesite—Atlin. David Gibb, Vancouver, B.C.

BRITISH COLUMBIA COPPER COMPANY'S EXHIBIT, GREENWOOD, B.C.

1. Chalcopyrite and pyrite—Mother Lode mine, Deadwood Camp.
2. Magnetite and pyrite— " " "
3. Magnetite— " " "
4. Ore in calcite gangue— " " "
5. Pyrite and chalcopyrite— " " "
6. Impregnated country rock: largely actinolite with scattered copper sulphides.
7. Country rock: greenstone.
8. Ore with garnetiferous gangue.
9. Actinolite.
10. Copper-gold ore, garnetiferous gangue—Oro Denoro mine, Summit Camp.
11. Galena and blende—No. 7 mine, Central Camp.
12. Copper-gold ore—Emma mine, Summit Camp.
13. Copper-gold ore—Lone Star and Washington mine.
14. Blister copper: slag—B. C. smelter.

Silver ore—Jewel mine, Sally mine, Prince Henry mine, and Elkhorn mine. Greenwood Mining division.

EXHIBIT OF CONSOLIDATED MINING AND SMELTING COMPANY, TRAIL, B.C.

1. Specimen of pig lead.
2. Specimen of bullion.
3. Bluestone.
4. Lead piping.
5. Anode.
6. Cathode.
7. High grade copper matte.
8. Low grade copper matte.
9. Copper-gold ores from the Centre Star and War Eagle mines, Rossland (large specimens).
10. Galena, St. Eugene mine, Moyie.
11. Twelve jars concentrates.
12. Roasted lead ore.

Grand Forks Mining Division, B.C.—

Copper-gold ore—Golden Eagle mine, Smiths creek, Grand Forks Mining division, B.C. R. K. Almond, Grand Forks.

ORES FROM THE OSOYOOS MINING DIVISION.

Mineral specimens from Camp Hedley: arsenopyrite (auriferous)—Metropolitan claim. Kingston Gold and Copper Mining Company.

Chalcopyrite with pyrrhotite and arsenopyrite—War Horse claim, Kingston group. Kingston Gold and Copper Mining Company.

Pyrite, arsenopyrite, zinc blende, and chalcopyrite—Golden Zone group, 11 miles from Hedley. Golden Zone Mining Company.

Chalcopyrite, pyrite, and pyrrhotite—Apex group. Colonial Gold Mining Company—W. D. McMillan, Vancouver, B.C.

Zinc blende and galena—Similkameen claim, Crown Point group (No. 2); arsenopyrite, Wellington group; pyrite and chalcopyrite, Cannon Ball group. F. Bailey, Merritt, B.C.

Arsenopyrite (auriferous) and associated rocks, Sunnyside No. 3 incline of the Nickel Plate group. Daly Reduction Company.

Gold-copper ore—Bullion group, near Olalla.

EXHIBIT FROM THE NICKEL PLATE MINE, HEDLEY, B.C.

M. K. Rodgers, Seattle.

1. Average ore as it goes to stamps.
2. Concentrates—gold, 8·70 ozs.; silver, 0·50 oz.
3. Tailings from vanners to cyanide plant.
4. Screened tailings after cyanide treatment, ore 60 mesh—0·12 oz. gold; 0·40 oz. silver.
5. Screened tailings after cyanide on 100 mesh—0·08 oz. gold, 0·3 oz. silver.
8. Screened tailings through 200 mesh after cyaniding—0·05 oz. gold, 0·04 oz. silver.
9. Screened tailings through 200 mesh after cyaniding—0·02 oz. gold, 0·01 oz. silver.
10. Nickel Plate ore—SiO_2, 85 per cent; Fe, 5 to 9 per cent; SO, 9 per cent.
11. Typical ore—4·1 ozs. gold; 1·2 ozs. silver.
12. Typical ore showing free gold—1·2 ozs. silver.
13. Monzonite—Nickel Plate mountain.
14. Andesite, phenocrysts of hornblende, plagioclase, in matrix of magnetite, quartz, and hornblende.
15. Rhyolite dike in ore body. Phenocrysts of orthoclase, plagioclase, quartz, hornblende. In matrix, orthoclase, quartz, calcite, apatite, enstatite, and hornblende.
16. Section of ore body.
17. Plan of reduction mill.

ORES FROM THE KAMLOOPS MINING DIVISION.

Galena—Tartar claim, Cottonbelt mines. E. A. Bjorckman.
Pyrite, chalcopyrite, and bornite—Iron Mask mine, Coal hill. Kamloops Mines, Limited.
Chalcopyrite—Monte Carlo claim, Coal hill. J. G. Rogers.
Chalcopyrite and pyrite—Iron Mask Mine, Coal hill. Kamloops Mines, Limited.
Chalcopyrite and pyrite from 500 ft. level.
Pyrite and chalcopyrite—Iron Cap mine, Kamloops.
Gypsum—Grande Prairie. W. A. A. Warren.
Chalcopyrite and pyrite—Kimberley group, Kamloops. A. Beckman.

ORES FROM THE NICOLA MINING DIVISION.

Bornite and chalcopyrite—Peacock group. T. Hunter.
Limonite—Chalybeate claim. Robert Pollard, Nicola.
Chalcocite—Big Sioux claim, Aspen Grove. C. Schmidt.
Melanterite—Parrot claim. Frank Bailey, Merritt.
Chalcocite—Aberdeen claim, Tenmile creek. Broomhead Syndicate, Nicola.
Chalcocite—Stand-by-for-Action claim, Tenmile creek.
Chalcopyrite—Copper King claim, Coutlee, Nicola valley. Robt. Waitshoair.
Chalcopyrite—Vancouver group, Aspen Grove. Shatford, Allan, and Co.

Chalcocite—New Westminster claim. Shatford, Carrington, and Co.
Native copper—Golden Sovereign group, Aspen Grove. Lowe and Brown.
Chalcocite—Bear Mountain group, Aspen Grove. Murray Bros. and Starwalt.
Native copper—Bluebell group, Aspen Grove. Lowe and Brown.
Chalcopyrite—Stubbles group, Lower Nicola. Stubbles Co.
Bornite—I.X.L. claim, Tenmile creek. Collis, Graham, and Co.
Bornite—U.X.L. claim of the I.X.L. group, Tenmile creek.

Native copper—Golden Sovereign claim, Aspen Grove, B.C. J. P. McConnell, Vancouver.

Quartz (au and ag)—Toto claim. F. Bailey.
Specularite—Manchester claim, Tenmile creek. John Clapperton.

Native copper—Aspen Grove. Frank Bailey, Merritt, B.C.

Column and slabs of marble—Nootka Marble quarries, Vancouver island. Nootka Marble Quarries, Limited, Victoria.

ORES FROM THE FORT STEELE MINING DIVISION.

Galena—North Star mine, Fort Steele Mining division. North Star Mining Co., Limited, Kimberley.
Galena—Stemwinder mine, Fort Steele Mining division. North Star Mining Co., Limited, Kimberley.
Two specimens of ore from the Grace Dore claim, Fort Steele Mining division.

Natron—Goodenough lake, Lillooet. F. Soues, Gold Commissioner, Clinton, B.C.

Kaolin and alunite—Kyuquot, west coast Vancouver island. W. F. Gibson, Vancouver.

Marble (three 10 inch cubes)—Marblehead quarries, Marblehead, B.C. Canadian Marble Works, Limited, Nelson, B.C.

Marble (10 inch cube)—Kootenay lake, B.C. W. G. Gillette, Nelson, B.C.

Marble (column and pedestal)—Nootka Marble quarries, west coast of Vancouver island, B.C. Nootka Marble Quarries, Limited, Victoria.

Sandstone (10 inch cube)—Denman island, B.C. Denman Island Stone Company, Vancouver.
Granite—Granite island, Blind bay, New Westminster Mining division, B.C. Kelly and Murray, Vancouver.

Brick and clay—New Westminster, B.C. E. J. Fader, New Westminster.

Sandstone (10 inch cube)—Hornby island, B.C. F. F. Murray, Vancouver.

ORES FROM THE NELSON, AINSWORTH, AND SLOCAN MINING DIVISION.

Character of Ore.	Mine.	Location.	Owner.	Address.
Copper-Gold ore	Arlington (E.)	Erie	Hastings, E. S	Nelson.
Silver-Lead	Bosun	Slocan	Bosun M. Co	N. Denver.
Silver-Lead	California	"	C. & C. S. L. M. Co	"
Silver-Lead	Wakefield	"	Wakefield Mines	Silverton.
Silver-Lead	Silver Bell	"	Prospect only	
Silver-Lead	Fisher Maiden	"	F. Maiden M. Co	"
Silver-Lead	Last Chance	Sandon	S. Cond M. Co	Nelson.
Silver-Lead	Enterprise	Slocan	E. M. C	"
Silver-Lead	Alpha	"	McNaught Bros	Silverton.
Silver-Lead	Hewitt	"	H. M. Co	"
Silver-Lead	Mountain Chief	"	G. W. Hughes	Sandon.
Silver-Lead	Mountain Boomer	"	Brandon Bros	Silverton.
Silver-Lead	Galena Farm	"		"
Silver-Lead	Standard	"	G. H. Aylard	N. Denver.
Silver-Lead	Noonday	"		"
Silver-Lead	Vancouver	"	Vanroi M. Co	Rossland.
Silver-Lead	Hampton	"		
Silver-Lead	Emily Edith	"	M. S. Davys	Nelson.
Gold ore	Foghorn	Ymir		
Gold ore	Wilson	"		
Gold ore	Arizona	"		
Silver ore	Hunter V	"	J. J. Campbell	"
Zinc blende	Molly Gibson	Kokanee	LaPlata Min. Co	"
Gold ore	Echo	Sheep creek		
Gold ore	Chio	Ymir		
Gold ore	Eureka	"		
Gold ore	Tally Ho	"		
Gold ore	Ballyhoo	Erie		
Gold ore	Fern	Hall creek	Fern G. M. & M	Nelson.
Silver-Lead	Emerald	Salmo	John Waldbeser	Salmo.
Gold ore	Eureka	Nelson	Anderson Mgr	Nelson.
Gold ore	Mica	"		
Silver-Copper	Silver King	"	L. Pratt	"
Silver-Lead	Vancouver	Slocan	Van-Roi Mining Co	
Gold ore	McEvoy	Ymir		
Gold ore	Ymir Belle	"		
Gold ore	Ore Hill	Salmo		
Gold ore	Ymir	Ymir	Ymir Gold Mining Co	Ymir.
Silver ore	Granite King	S. F. Kaslo	J. F. McIntosh, S. Fork, Kaslo creek	Kaslo.
Silver ore	Gray Eagle	"	J. F. McIntosh, S. Fork, Kaslo creek	"
Blende ore	Province	"	Province Mines, S. Fork, Kaslo creek	"
Silver ore	Montezuma	"	M. Mines, S. Fork, Kaslo creek	"
Silver ore	Cork	"	Selkirk M. Co	"
Silver ore	Revenue	"	L. McLean, S. Fork, Kaslo creek	"
Gold quartz	Kootenay Belle	Salmo	J. McMaster	Salmo.
Gold quartz	Mother Lode	"	J. McMaster	"
Gold quartz	Granite	Nelson	Granite Mines	Nelson.
Silver-Lead-Zinc	Blue Bell	Kootenay lake	Can. Metal Co., S. S. Fowler, M. E. Mgr. 4 spec	Riondel.
Native silver	Krao	Ainsworth	W. S. Zwicky	Kaslo.
Silver-Carbonate	L. H. G. Gal'r	"	A. D. Wheeler	Ainsworth.
Iron and gold	Grant	"		"
Silver-Lead	Maestro	"	H. Giegerich	Kaslo.
Silver-Lead	Highlander	"	H. M. Co	Ainsworth.
Silver-Lead	R. Cariboo	Macguigan	Rambler C. Co	Kaslo.
Silver-Lead	Whitewater	Whitewater	W. M. Co	"
Zinc	Lucky Jim	Bear lake	G. W. Hughes	"
Silver-Lead	Ruth	Sandon	Ruth Mines (3 sps.)	"
Silver-Lead	Jackson	Jackson basin	Jackson Mines	"
Silver-Lead	Early Bird,	Sandon	J. S. C. Fraser	Rossland.
Silver-Lead	Elkhorn	"	J. W. Stewart	Sandon.
Silver-Lead	Marie Fraction	"	J. Kelson	"
Silver-Lead	Mercury	"	Cunning and others	"
Silver-Lead	R. Eureka	"	Can. Con. M. & S. Co	Trail.

ORES FROM THE NELSON, AINSWORTH, AND SLOCAN MINING DIVISION—*Continued.*

Character of Ore.	Mine.	Location.	Owner.	Address.
Silver-Lead	Neglected	Sandon	Black & Cameron	Sandon.
Silver-Lead	S. Sovereign	"	C. F. Ranson	"
Silver-Lead	Ivanhoe	"	Minn. S. M. Co	"
Silver-Lead	Tamarac	Springer creek	G. Henderson	Slocan City.
Silver-Lead-Gold	Phœnix	"	G. Henderson	"
Silver-Lead	Hamilton	Twelvemile creek	Ralph Gillet	"
Silver-Lead	Deadwood	Springer creek	Angus McVicar	"
Silver-Lead	Cal. and Hecla	"	W. M. Clement	"
Silver-Lead-Gold	Morning Star	"	W. M. Clement	"
Silver-Lead	Thora	Tenmile creek	D. McCuaig	"
Silver-Lead	Red Fox	Sandon	G. Henderson	"
Silver-Lead	Arlington (S.)	Slocan	Arlington Mines	"
Silver-Gold	Ottawa	Springer creek	Ottawa M. Co	Nelson.
Native silver	Molly Hughes	Slocan	M. Zattoni	N. Denver.
Gold-Silver-Lead	Yankee Girl	Salmo	Y. G. M. Co	Salmo.
Antimony	....	.....	Stmr. Slocan	Slocan Lake.
Gold ore	Nugget mine	Sheep creek, Nelson	A. Gracey	Nelson.
Gold ore	Eureka mine	Fortynine creek	.....	"

Free milling gold quartz—Cholla group, Lardeau Mining division, Camborne, B.C. Imperial Division Syndicate.

Free milling gold quartz—Eva mines. Eva Gold Mines, Limited, Camborne, B.C.

Silver ore, Silver Cup—Trout Lake Mining division. F. C. Merry, Ferguson.

Portland cement—Victoria, B.C. Vancouver-Portland Cement Company.

Crude petroleum—Flathead river, East Kootenay, B.C. Bureau of Mines, Victoria, B.C.

Gypsum—Thompson river, opposite Spatsum, Canadian Pacific railway. Sinclair Spencer, Vancouver.

GOLD, COPPER, AND SILVER ORES FROM THE QUEEN CHARLOTTE MINING DIVISION.

Chalcopyrite—Copper Queen mine, Jedway.
Bornite and chalcopyrite—Swede group, Lockeport.
Chalcopyrite—Lily group, Ikeda bay.
Chalcopyrite—Oceanic mine, Collison bay.
Magnetite with chalcopyrite and pyrite—Reco mine, Harriet harbour, Jedway.
Magnetite with chalcopyrite and pyrite—Modoc mine.
Bornite—Last Chance claim, Lockeport.
Chalcopyrite—Thunder mine, Collison bay.
Chalcopyrite and pyrrhotite—Contact group, Tasoo harbour.
Magnetite and chalcopyrite—Maggie C claim, Huston inlet, Jedway.
Bornite—North Star claim, Gold harbour, west coast.
Chalcopyrite—Peerless group, Carpenter bay.
Chalcopyrite and bornite—Bismark claim, Lockeport.
Chalcopyrite—Trust mine, Copper island.
Chalcopyrite—Moresby Island mine, Jedway.
Chalcopyrite—Iron group, Huston inlet, Jedway.
Chalcopyrite—Gold Cliff mine, Huston inlet, Jedway.
Chalcopyrite—Iscoyd mine, Huston inlet, Jedway.

Pyrite—Arctic Robin group, Lockeport.
Chalcopyrite and pyrite—Meal Ticket mine, Collison bay.
Chalcopyrite—Warwick group, north slope of Moody mountain, south side Tasoo harbour. Tasoo Mining and Smelting Company, Tasoo harbour.
Chalcopyrite and pyrite—Ikeda Bay mine, Ikeda bay.
Chalcopyrite—Moody mine, Tasoo harbour. Elliott Mining Company.

GOLD-COPPER ORES FROM THE SIMILKAMEEN MINING DISTRICT.

Chalcopyrite and pyrite—Copper mountain. E. F. Voight.
Chalcopyrite and pyrite—Canadian Belle claim. McRae Bros.
Auriferous quartz—Granite claim, Granite creek.
Chalcopyrite—Oriole claim, Copper mountain. Snowdon Bros. and Day.
Gold-copper ore—Copper mountain. E. F. Voight.
Auriferous quartz—Gold Crown claim, Granite creek, east slope. Fitzgerald Bros. Ledge, 2 feet.
Gold-copper ore—Triangle claim, Copper mountain. Thomas Bros., Princeton.
Chalcocite—Voight Camp, Similkameen. McRae Bros.
Copper ore—Azurite claim, Voight Camp. McRae Bros.
Chalcopyrite—Oriole No. 2 claim, Copper mountain. Snowdon Bros. and Day, Princeton.
Chalcopyrite—Copper Farm, Copper mountain. Sanders and Millar.
Chalcopyrite—H. H. Gardner claim, Copper mountain. Sanders and Millar.
Chalcopyrite—Sunrise claim, Copper mountain. Burr and Jones.
Chalcopyrite—Reco claim, Copper mountain. Bank of Montreal.
Chalcopyrite—Jenny Silkman claim, Copper mountain. French and Day.
Chalcopyrite—Silver Dollar claim. Cramer and Bryant.
Copper-gold ore—Red Eagle No. 2 claim, Copper mountain. E. A. Thomas, Princeton.
Chalcopyrite—Princess May claim. Charles Powell.
Bornite—Smuggler claim, Copper mountain. Willarson and Johnson.
Chalcopyrite—Long Jim claim, Fivemile creek, Similkameen. Cox and Uhlan.
Chalcopyrite—Bull Dog claim, Fivemile creek. F. Fracas.
Galena—Skagit, Similkameen. L. Gibson, Princeton.
Chalcopyrite—Stevenson claim, 5 miles below Princeton on river opposite Holmes' ranch, Similkameen. Willarson and Johnson.
Chalcopyrite—Mogul No. 1, Kennedy mountain, Similkameen.
Chalcopyrite—Gladstone claim, Friday creek. F. M. Gillespie, Hedley.
Chalcopyrite—Blue Ridge claim, Fivemile creek. Cox and Uhler.
Galena with pyrite—Summit. R. Stevenson, Princeton.
Chalcopyrite—Red Buck claim, Kennedy mountain. Allison and Revely.
Azurite and malachite—Ada B. claim, Copper mountain. Willarson and Johnson.
Chalcopyrite—Sunset claim, Copper mountain. Sanders and Millar.
Chalcopyrite—Mogul No. 2, Kennedy mountain. Willarson and Johnson.
Chalcopyrite—Red Star claim, Roche river. Powell and Bonnivier.
Bornite—Gladstone claim, Friday creek. Wheeler *et al.*
Coal—Princeton (24 ft. seam). Vermilion Forks Mining Company.
Coal—West Fork of Granite creek. Empire Development Company.

EXHIBIT OF THE GRANBY CONSOLIDATED MINING, SMELTING, AND POWER COMPANY, GRAND FORKS, B.C.

Gold-copper ores from Phœnix, and blister copper from the Smelter, Grand Forks.

Gold-copper ore—Le Roi mine, Rossland, B.C., from the 600 and 1,650 ft. levels; two specimens. Le Roi Mining Company, Limited, Rossland.

Gold-copper ore—Hamilton vein, Josie mine, Rossland, 500 ft. level; East Hamilton vein, 300 ft. level; West Hamilton vein, 500 ft. level. Le Roi No. 2 Mining Company, Limited.

ORES FROM BEAR RIVER, PORTLAND CANAL, SKEENA RIVER MINING DIVISION, CASSIAR, STEWART MINING AND DEVELOPMENT COMPANY, VICTORIA, B.C.

1. Pyrite with galena and native silver—Lucky Seven and Little Joe claims, Glacier creek. Portland Canal Mining Company, Duncans, B.C.
2. Pyrite with galena—Geo. E. and Ben Hur claims, Glacier creek, Bear river.
3. Galena and blende—Glacier creek, Bear river.
4. Galena and blende—Main reef, Glacier creek, Bear river.
5. Galena, blende, and chalcopyrite—Rainier claim, Bear river.
6. Galena—Maybee claim, American creek.
7. Chalcopyrite, blende, and bornite—Bandolier claim, American creek.
8. Chalcopyrite—London group.
9. Molybdenite—Observatory inlet.

Pyrite and galena (auriferous and argentiferous)—Gipsy claim. Portland Canal Mining Company, Duncans, B.C.

Pyrite and galena with native silver—Lucky Seven and Little Joe claims, Glacier creek. Portland Canal Mining Company, Duncans, B.C.

Ores of gold and silver from the O.K. and Little Wonder claims. Pereault and Chapman, Stewart, B.C.

Chalcopyrite and pyrite—Hidden creek, Goose bay, Observatory inlet, B.C. M. K. Rodgers, Seattle.

Gold-copper ore—Maple Bay mine, Portland canal, B.C. Wm. Noble, Vancouver.

EXHIBIT OF THE TYEE COPPER COMPANY, LIMITED, VICTORIA, B.C.

1. Ore from the Britannia mine—Howe sound.
2. Ore from the Cornell mine—Texada island.
3. Ore from Valdez island.
4. Ore from Sydney inlet (Indian Chief mine).
5. Ore from Prince of Wales island.
6. Specimen of copper matte made from the above ores by the Tyee Copper Company. Forty per cent copper.
7. Ore from the Arctic Chief, Whitehorse, Y.T.
8. Ore from Ikeda Bay mines, Queen Charlotte islands.
9. Ore from the Pueblo mine, Whitehorse, Y.T.
10. Three copper ingots made from ore smelted at the Tyee smelter, Ladysmith.
11. Photos of smelter and shipping pier, Ladysmith, B.C.

Chalcopyrite and pyrite—from the Jane mine, Britannia Beach, Howe sound. Britannia Mining and Smelting Company, Limited, Britannia Beach, B.C.

Iron pyrites—Ecstall inlet, Skeena river, B.C. B.C. Pyrites Company, Victoria, B.C.

Arsenopyrite—Bonanza mine, Hope, Yale Mining division. Victor George, Hope.

ORES FROM TEXADA ISLAND.

Bornite—Little Billy claim, Texada island. J. T. Taylor, Van Anda.
Pyrite and chalcopyrite—Florence Case, Texada island. J. T. Taylor, Van Anda.
Chalcopyrite—Loyal lease, Texada island. James Raper, Van Anda.
Chalcopyrite and bornite—Loyal lease, Texada island. James Raper, Van Anda.
Bornite—Rose and Bell claim, Texada island. James Raper, Van Anda.
Iron ochre—Iron Crown claim, Texada island. P. A. Staaf, Van Anda.
Bornite, chalcopyrite, and native silver—Marble Bay mine, Texada island, B.C., 960 ft. level. Tacoma Steel Company, Van Anda, B.C.
Bornite and chalcopyrite—Cornell mine, Van Anda, Texada island, 360 ft. level. Northern Texada Mines, Limited, Vancouver.

ORES FROM VANCOUVER ISLAND, V.I. DEVELOPMENT LEAGUE, VICTORIA, B.C.

Clay ironstone—No locality.
Bog iron ore—Quatsino.
Copper ore—Koksilah, Cowichan.
Copper ore—New shaft, Copper Cañon claim, Mount Sicker.
Copper ore—Mounts Sicker and Breton mines, Copper cañon.
Azurite—No locality.
Magnetite—Hesquot.
Magnetite—Sarita river, above Banfield creek.
Antimony—Gordon river, Renfrew district.
Copper ore—Patchena claim, Gordon river.
Cinnabar—West coast, Vancouver island. F. H. Mayhew, Victoria.
Native arsenic—Koksilah.
Copper ore—Virginius claim, Maxwells Peak, Saltspring island. A. F. Gwin.
Zinc blende—Vancouver island.
Graphite—Renfrew district.
Copper ore—Monitor claim, Alberni canal.
Copper ore—Yreka claim, Comstock mountain, Quatsino sound.
Copper ore—Lenora mine, Mount Sicker.
Copper ore—King Solomon mine, Cowichan station.
Auriferous quartz—Elk river, Kennedy lake.
Copper ore—Cascade mountain, Alberni.
Copper ore—Quatsino sound.
Copper ore—Sicker mine, Mount Sicker.
Copper ore—Johns claim, Mount Sicker.
Copper ore—Saltspring island, B.C. Neave Saunders.
Copper ore—Belle mine, Mount Sicker.
Copper ore—Southern Cross mine, Uchucklesit.
Copper ore—Cowichan lake.
Copper ore—Happy John mine, Alberni.
Copper ore—Little May claim, Hettie Green group, Clayoquot, Tofino.

Gold-copper ore—Blue Bird and Willow Grouse claims, Sooke, Vancouver island. R. F. Tolmie, Victoria.

Ores from Yukon Territory.

Bornite and chalcopyrite—Copper King mine, Whitehorse.
Bornite in tremolite—Copper King mine, Whitehorse.
Chalcopyrite and bornite in magnetite—Arctic Chief mine, Whitehorse.
Chalcopyrite and azurite with tetrahedrite—Arctic Chief mine, Whitehorse.
Bornite—Anaconda mine, Whitehorse.
Bornite and chalcopyrite—Grafter mine, Whitehorse.
Bornite and chalcopyrite—War Eagle mine, Whitehorse.
Bornite, chalcopyrite, and magnetite—Le Roi mine, Whitehorse.
Bornite and malachite—Keewenaw mine, Whitehorse.
Specular iron with copper carbonates—Pueblo mine, Whitehorse.
Bornite with malachite—Rabbit-foot mine, Whitehorse.
Chalcopyrite—Best Chance mine, Whitehorse.
Chalcopyrite—Valerie mine, Whitehorse. A. B. Palmer, Vancouver.
Bornite—Empress of India mine, Whitehorse.
Chalcopyrite—Valerie mine, Whitehorse.
Galena, sphalerite, and pyrite—Conrad mines, Windy Arm.
Pyrrhotite, sphalerite, and galena—Venus mine, Conrad.

Chalcocite—Arctic Chief mine, Whitehorse.
Chalcopyrite—Valerie mine, Whitehorse.
Copper ore with specularite—Pueblo mine, Whitehorse.
Native copper from White river, Y.T. Capt. John Irving, Victoria, B.C.

Four gold nuggets from Griffith's claim—Wild Horse creek, Fort Steele Mining division, East Kootenay, B.C., 7 ozs. 16 dwts. 8 grains. Geological Survey.

Auriferous gravel—Eldorado creek, containing 5·32 ozs. gold, Klondike, Y.T. Value, $85.

Model of gold nugget—Slate creek, Cassiar, B.C. Geological Survey.
Model of gold nugget—Willow creek, Atlin, B.C. Presented by W. F. Robertson, Provincial Mineralogist, Victoria, B.C.

Auriferous gravel—United mines, Bonanza creek, Adams hill, Y.T. Geological Survey.

Coal and coke—Fernie, B.C. Crows Nest Pass Coal Company, Limited, Fernie, B.C.

Coal—Middlesboro collieries, Nicola valley, B.C. Nicola Valley Coal and Coke Company, Limited, Vancouver, B.C.

Coal—South Wellington, Vancouver island, B.C. Pacific Coast Coal Mines, Limited, Victoria, B.C.

Coal—Suquash, Vancouver island, B.C. Pacific Coast Coal Company, Limited, Victoria, B.C.

Coal—Wellington colliery, Extension, Cranberry district, Vancouver island, B.C. Wellington Colliery Company, Limited, Victoria, B.C.

Coke—Comox mine, Vancouver island, B.C. Wellington Colliery Company, Limited, Victoria, B.C.

Coal—Princeton, B.C. Vermilion Forks Mining Company.

Coal and coke—Coleman, Alberta. International Coal and Coke Company, Limited, Coleman, Alta.

Anthracite and briquettes—Bankhead mines, Alberta. Bankhead Mines, Limited, Bankhead, Alta.

Coal—Granite creek (West fork), Similkameen Mining division, B.C. Empire Development Company.

ARCTIC EXPLORATION.

(R. A. A. Johnston.)

The following specimens collected by Captain J. E. Bernier during the cruise of the Canadian steamship *Arctic* in 1908-9, have been donated to the Museum:—

List of materials contributed by Captain J. E. Bernier from the expedition of 1908-9, November 8, 1909:—

1. Board with instructions indicating the position of Capt. Kellett's depot, Dealy island, Melville island.
2. Record box found in Captain Henry Kellett's depot, Dealy island, Melville island.
3. Pole found on Melville island—Sir Edward Parry—1819-20.
4. Hand bars, Melville island—Sir Edward Parry—1819-20.
5. Maul (ship's), *Resolute*, 1851-3, Melville island.
6. Adze, H.M.S. *Resolute*—Capt. Henry Kellett—1851-3.
7. Eskimo toy, Pond inlet.
8. Rope found Bay of Mercy—*Investigator* expedition, 1850-2.
9. Prayer book, Melville island—Sir Edward Parry—1819-20.
10. Tent peg, Melville island—Sir Edward Parry—1819-20.
11. Lead bullets, Cockburn point, date 1851.
12. Two Eskimo pipes.
13. Polar bear teeth.
14. Fox skulls.
15. Two pieces of rope from Sir John Franklin's monument.
16. Piece of wood from yacht *Mary*—Capt. John Rose—1854.
17. Record box left by Commander A. P. Low.
18. Drift wood, Liddon gulf, found by Reuben Pike, ss. *Arctic*, 1909.
19. Box of teeth, shells, buckles, buttons, etc., Melville island.
20. Piece of porcelain found on Beechy island, September, 1906, relics of the North Star expedition of 1854.
21. Wash-mop, Parry expedition, 1819-20.
22. Record in bottle, whaler *Esquimaux*—Capt. Philips—1891.
23. Wood from Parry expedition, 1819-20.

24. Wood and rope, Cape Haven, Baffinland.
25. Wood, coal, and ivory, Liddon gulf, 1906.
26. Piece of bunk of a boat at Erebus bay, September 2, 1908.
27. Coiled brass shell for some old type of rifle, found at Beechy island, 1906.
28. Piece of pick, found on Cockburn island, 1906.
29. Piece of bone with names of travellers.
30. Bullets of various calibres cut from musk oxen.
31. Two pieces of broken earthenware, Parry's expedition of 1819-20.
32. Glass, nails, etc., from Parry's expedition of 1819-20.
33. Perforated sheet of copper, from one of the sloops left by Franklin, Beechy island.
34. Portions of copper vessel left by William Parry—found on Melville island.
35. Piece of sheet copper, found on Melville island just north of Winter harbour. Relics left by William Parry.
36. Lamp bottom, left by William Parry on Melville island.
37. Tent pegs, left by Capt Sabine on Melville island.
38. Box handle, Melville island; left by William Parry.
39. Rowlock socket, taken from one of the sloops left by Franklin, Beechy island.
40. Two guns, from Depot House of Kellett and McClintock, Dealy island, Melville island.
41. Parts of a thermometer, from the *Resolute* of 1851-3.
42. Piece of a board, from the yacht *Mary*—Sir John Ross—1850-1.
43. Some pieces of board, taken from an old boat, part of Sir Edward Belcher's North Star expedition.
44. McClintock's record box, June 11, 1851.
45. Sweater, found in a cask at Depot House, Dealy island, Melville island, August 31, 1908. J. D. McMillan, ss. *Arctic*.
46. Relics from fireplace of Parry's expedition, Melville island, 1819-20.
47. Books, etc., 19 in number, from the Depot House of H.M.S. *Resolute*—Capt. Henry Kellett—1851-3, Melville island, lat. 75° N. and long. 109° W.
48. Pole stadia, Melville island.
49. Barrel of flour, 360 pounds, from the Depot House of H.M.S. *Resolute*—Capt. Henry Kellett—1851-3.
50. Box ammunition, from the Depot House of H.M.S. *Resolute*—Capt. Henry Kellett—1851-3.
51. Musk ox head.
52. Skin of Northern gyrfalcon.
53. Skin of snowy owl.
54. Skin of loon.
55. Skin of barren ground caribou.
56. Skin of wolf.

Also a collection of minerals, rocks, coal, etc., from points in the Arctic regions visited by Captain Bernier during the cruise of ss. *Arctic* in 1908 and 1909.

ARCHÆOLOGY AND ETHNOLOGY.

In order to secure adequate office space, it has been found necessary to remove the exhibits in the 'Indian room.' An inventory of these is being taken, and they are being packed for transfer to the Victoria Memorial Museum.

The following additions have been made to the collection during the year:—

DONATIONS.

Mr. Bernhard Marcuse, Montreal:—

Arrowhead, found by Miss Gibson on the shore of Nicolet lake, near Danville, Richmond county, Quebec.

Mr. George C. Holland, Ottawa:—

Two stone axes and a stone gouge, found on Skead's limits, Madawaska river, Ontario.

John L. Retallack, Esq., Kaslo, B.C.:—

Canoe made by the Kootenay tribe of Indians.

Joseph Streit, Esq., Kaslo, B.C.:—

Stone hammer head—Kootenay Indians, Kootenay lake, B.C.

PALÆONTOLOGY AND ZOOLOGY.

(Lawrence M. Lambe.)

My study of the Palæoniscid fishes of the Albert shales of New Brunswick, begun in 1908 and referred to in the Summary Report for that year, was continued during the early part of the past year, and occupied most of my time until June. By that time the manuscript descriptive of these fishes was completed, as were also the drawings and photographs for eleven illustrative plates, the whole forming a monograph on the Albert shales fishes, to be issued as part V, of volume III (quarto), of Contributions to Canadian Palæontology.

A short time toward the end of May was given to the preparation of a paper entitled 'The Fish Fauna of the Albert Shales of New Brunswick.' This paper, illustrated with one plate, appeared in the August number of volume XXVIII of *The American Journal of Science.*

A Bibliography of Canadian Zoology for 1907 (exclusive of Entomology) was written during the early part of the year, and presented at the annual meeting of the Royal Society of Canada for publication in its transactions.

Part IV, of Volume III (quarto) of 'Contributions to Canadian Palæontology' was published in March last, and has since been distributed. This memoir is descriptive of 'The Vertebrata of the Oligocene of the Cypress hills, Saskatchewan,' and consists of 82 pages of letter-press, illustrated by 13 text figures and 8 photogravure plates.

FIELD WORK.

During the summer of 1909, a month was devoted to field work; the principal object of which was to obtain additional remains of fishes from the lower Devonian rocks of Campbellton, N.B.

Leaving Ottawa on July 12, for New Brunswick, a few days were first spent, in company with Mr. W. J. Wilson, at and near St. John, N.B., where I had been instructed to examine certain Laurentian beds stated to contain spicular remains of sponges. At two localities, one in the city of St. John, on the north side of St. John river, a few hundred yards above the railway bridge, the other at Drury cove, about 4 miles north of the city, occur rocks which have been regarded as of Laurentian age, and which have been so mapped by the Geological Survey. *Halichondrites graphitiferous*, Matthew,[1] has been described from the graphitic shales of the first locality. The quartzites and limestones of the second locality have furnished material for the description of *Cyathospongia* (?) *eozoica*, Matthew,[2] . . . Strict search, made at both of these places, revealed nothing that was recognized as of spicular origin; although in the graphitic shales near the St. John bridge certain markings were observed, which appeared to be of the nature of lines of crystallization, bearing some resemblance to the figure accompanying the description of *Halichondrites graphitiferous.*

Proceeding to Campbellton, a collection was made of the remains of fishes and plants preserved in the lower Devonian rocks, exposed for some distance as low cliffs along the river front, above the town. This collection will form a welcome addition to the material from this locality already in the possession of the Geological Survey; not only as a help in further study of the interesting fauna and flora of these rocks, but also for exhibition purposes.

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[1] Bull. Nat. Hist. Soc. of New Brunswick. No. IX, p. 42, fig. 2, 1890, 'On the Occurrence of Sponges in the Laurentian Rocks at St. John, N.B.'

[2] Idem, p. 43 (with figures).

Later, some time was spent on the north shore of Gaspé bay, where the Gaspé sandstones, forming cliffs eastward from Peninsula, give place at Grande Grevé to the underlying Gaspé limestones, which are found outcropping from here eastward to Indian cove. A collection was made of the fossils of the limestones to supplement the specimens in the museum of the Geological Survey, which do not fully represent this particular fauna.

Since March last, the duties of Palæontologist and Zoologist have been performed by the writer. These have included the examination and determination of collections of fossils and recent forms made by officers of the Department, and of others submitted by institutions and individuals. They have also necessitated a large expenditure of time in correspondence, many letters having the nature of reports.

As regards collections, the following have been examined and reported on:—

Mr. Owen O'Sullivan:—

A small collection of fossils made in 1908, on Shamattawa and Severn rivers, and on the south coast of Hudson bay.

Mr. G. A. Young:—

A collection of fossils (principally corals), made in 1908 at Belledune, and at Limestone point, on the south shore of Chaleur bay.

Collections made by Mr. Young in 1909 at Tetagouche river, at two localities near Petite Roche station on the Intercolonial railway, and at Belledune point, Chaleur bay.

Mr. E. R. Faribault:—

A small collection of fossils made in 1907 at a number of localities in Mahone bay, Lunenburg county, N.S.

Mr. W. McInnes:—

A few fossils obtained in 1909, near and to the south of Lac LaRonge, Saskatchewan.

The Dominion Government Arctic Expedition of 1908-9:—

A collection of fossils, recent shells, etc., made by Mr. McMillan, the geologist to the expedition, on Beechy, Melville, Banks, and Bathurst islands. The fossil plants of this collection were determined by Mr. W. J. Wilson.

The Smithsonian Institute, Washington, D.C.:—

A few recent marine sponges, from the coast of British Columbia, submitted by the National Museum.

Mr. W. W. Leach:—

Fossils collected in 1907, in the Skeena River district, B.C., at two localities, viz., Hudson Bay mountain, Zymoetz river; and Bulkley river, 10 miles south of Moriceton.

ADDITIONS TO THE PALÆONTOLOGICAL AND ZOOLOGICAL COLLECTIONS DURING 1909.

Collections and specimens, as follows, were received from members, and employes, of the Geological Survey:—

Cairnes, D. D.:—

One crushed specimen of an ammonite from near Union mines, Wheaton River district, Yukon. This fossil is clearly referable to the species obtained by Mr. Cairnes in 1906 from Union mines, and determined by Dr. Whiteaves as *Prionocyclus woolgari* (Mantell), Cretaceous.

Camsell, C.:—

A small collection of plants from Tertiary shales (Oligocene), Collins gulch, Tulameen river, B.C. Determined by Mr. W. J. Wilson.

Five specimens of plant-like remains from shales of presumably Triassic age, Slate creek, Tulameen river, B.C.

Ells, S. C.:—

Portions of the rhizomes of *Psilophyton princeps*, Dawson, from Narrows brook, a tributary of York river, 25 miles from Gaspé basin; from grey beds of sandstone belonging to the Gaspé Sandstone series (upper Devonian). The specimens are from a layer, 4 to 5 inches thick, made up entirely of flattened, horizontally disposed rhizomes of this species. They are charged with hydrocarbons, and kindle readily into flames when ignited.

Dowling, D. B.:—

Collections of fossils from the foothills of the Rocky mountains, Alberta, between Saskatchewan and Athabaska rivers, as follows:—

Fifteen fossil shells, from the Cardium sandstone (middle Colorado formation), between Bighorn river and Wapiabi creek, Alberta.

Two fossil shells, from the Kootanie formation, Raven creek—a branch of Saskatchewan river, Rocky mountains.

Five fossil plants, from the top of the Kootanie formation, Raven creek.

Twelve fossil plants, from the upper part of the Cardium sandstone, Taylor creek, a branch of Brazeau river, Alberta.

Two fossil shells, from the Claggett shale, Taylor creek.

Twenty-five fossils (shells and plants), from the Kootanie formation, head of the south branch of McLeod river, Alberta.

Johnston, W. A.:—

About sixty specimens of crinoidea, cystidea, and starfishes, from the Trenton limestone along the Trent Valley canal, near Kirkfield, Ont.

About fifty specimens of fossils, from the supposed Black River and Birdseye (Lowville) limestone, on the west side of Lake Couchiching, Ont.

Lambe, L. M.:—

Graphitic shale, mapped as of Laurentian age, from the north side of St. John river, about 200 yards above the railway bridge, St. John, N.B.

A collection of fish and plant remains, from the lower Devonian rocks of Campbellton, N.B.

A collection of fossils from the Gaspé limestones (Grande Grevé limestone) of the north shore of Gaspé bay, between Little Gaspé and Indian cove.

Leach, W. W.:—

A collection of plant remains, comprising four or five species, from rocks of presumably lower Cretaceous (Kootanie) age, from Twentymile mountain, about 20 miles by trail (or 10 miles in a straight line) northeast of Hazelton, B.C.

Leaves (one specimen), apparently referable to *Sequoia heerii*, Lesq, from Driftwood creek, Bulkley valley, B.C.; collected in 1908. This species has been recorded (Penhallow) from the Tertiary lake deposits of the interior of British Columbia. The shale on which the leaf impressions are preserved, resembles that of the fish, insect, and plant-bearing beds of the Quilchena and Tulameen areas.

Malloch, G. S.:—

Three corals, from the slope of Red mountain, on the north side of Fraser river, B.C., 110 miles above Fort George, from limestone beds which are apparently synchronous with McConnell's 'Intermediate limestone' of the Bow valley, and probably about the age of the Hamilton formation (upper Devonian). Two of the specimens are *Cladopora cervicornis*, de Blainville; the third is fragmentary, and is probably a Cyathophyllum.

McInnes, W.:—

A few fossils from rocks of middle Devonian age (Stringocephalus zone), Lac LaRonge, Saskatchewan.

McKinnon, A. T.:—

One specimen of the recent marine sponge, *Desmacidon* (*Homœodictya*) *palmata*, Johnston, from Two Islands, N.S. This sponge, originally described from Great Britain, is a common form in the waters of the Bay of Fundy, and off the coast of Nova Scotia, as well as the northeast coast of the United States.

Wilson, W. J.:—

A collection, of about 2,000 specimens, of Devonian and Carboniferous plants, from the following localities in New Brunswick: Little Lepreau; Kennebecasis island; Moosehorn brook, Norton; Gardner creek; Tynemouth creek; Cape Enrage; Mary point; Grindstone island; Minto, Grand lake; and Beersville, Kent county.

A few fossils from Trenton beds at the peninsula, west side of Dow lake, Central Experimental Farm, Ottawa, Ont.

Young, G. A.:—

Over thirty pieces of black carbonaceous slate, of Ordovician age, holding graptolites; from the north bank of Tetagouche river, above the crossing of the Intercolonial railway, near Bathurst, Gloucester county, N.B.

A few Silurian fossils, collected on the bank of a stream that is crossed by the Intercolonial railway, about one and a quarter miles north and west of Petite Roche station. The exposure is situated on the stream about 300 yards below the railway crossing.

A few fossils, from a point on the Intercolonial railway about 2 miles north and west from Petite Roche station, and about 300 yards from the locality just mentioned. Silurian.

A small collection of fossils (Silurian), from an exposure of rocks on a small stream at a point slightly over 2 miles nearly due south of Belledune point, south shore of Chaleur bay.

Additions to the Palæontological and Zoological Collections from other Sources, during the past Year.

(A.) PALÆONTOLOGY.

By presentation:—

Bernier, Captain:—

Fossil corals, from the Silurian of Erebus bay (Beechey island), southern end of Wellington channel, viz., three specimens of *Acervularia austini*, Salter; and one of *Strephodes pickthornii*, Salter.

Evans, W. B., Manager of the Rothwell Coal Company, Limited, Minto, Sunbury county, N.B. (per W. J. Wilson):—

About twenty well preserved specimens of Carboniferous (Millstone Grit) plants from the Rothwell Coal mine.

Grant, Colonel C. C., Hamilton, Ont.:—

Two fossils from the Clinton formation, and eight from the Niagara chert, at Hamilton, Ont.; three from the Niagara formation at Barton, Ont., and four from the drift at Winona, Ont.

Lafrance, Mrs., Montcerf, Que.:—

Diatomaceous earth, from a fresh-water deposit 2 miles from Montcerf (near Maniwaki), Ottawa county, Que.

With the diatoms occurs a small proportion of fresh-water sponge spicules.

Foster, Wilson, Dawson, Yukon:—

Molar of *Elephas primigenius*, Blumenbach (Northern Mammoth), from the auriferous gravel, on bed-rock, Eldorado creek, Klondike, 1903.

Malcolm, John, Fergus, Ont.:—

Eleven fossils from the Guelph formation at various localities in Ontario.

Penfold, A., Ottawa East:—

A caudal vertebra of *Delphinapterus leucas*, Pallas, found by Mr. Penfold at Ottawa East, at a depth of 25 feet below the surface, whilst digging a well.

Wilmer, Lieut.-Colonel L. Worthington, Lothian House, Ryde, England:—

Forty-five fossils from the English chalk, and eight other geological specimens therefrom; also two specimens of the living *Purpura lapillus*.

By purchase:—

Four specimens of insects preserved in amber.

A complete skull of the Pleistocene horse (*Equus caballus*, L.), female, from the auriferous gravel, close to bed-rock, at a depth of 35 feet from the surface, on creek placer mining claim, No. 34, Gold-run creek, Yukon.

(B.) ZOOLOGY.

By presentation:—

Garneau, A. L., Ottawa, Ont.:—

A clutch of five eggs of the robin (*Merula migrataria*), taken at Ottawa, May 22.

Young, Reverend Charles J., Madoc, Ont.:—

Seven specimens of the land shell *Patula alternata*, Say, from the shore of Lake Ontario, near Wellington.

Dominion Government Arctic Expedition of 1908-9:—

One pair of horns of musk ox, female.

One specimen of recent marine sponge (Suberites), from Port Leopold, 1907.

A card catalogue of the fossil collections of the Geological Survey was begun on November 12, by Mr. W. J. Wilson, who is assisted in the work by Miss A. E. Wilson.

PALÆONTOLOGICAL MATERIAL FROM THE DEVONIAN AND CARBONIFEROUS OF SOUTHERN NEW BRUNSWICK.

(W. J. Wilson.)

INTRODUCTION.

In accordance with instructions, the past summer was spent in making a collection of fossil plants from the Devonian and Carboniferous formations of southern New Brunswick—being a continuation of the work begun the preceding year—for the purpose of determining more accurately the boundaries of the formations. The brief study given the collection of 1908 showed that it was desirable to obtain a more complete set of specimens from some of the localities, and to collect from places not examined last year.

In carrying out the work, I am indebted to Dr. Geo. F. Matthew, and Mr. Wm. McIntosh, of St. John; to Hon. James Barnes, president of the Northfield Coal Company, Limited, Minto, Sunbury county; and to Messrs. Meede and Shaw, managers of the Beersville Coal Mines, Kent county, for valuable assistance; also to Mr. W. B. Evans, manager of the Rothwell Coal Company, Limited, Minto, for a splendid collection of fossil plants, which he kindly donated to the Museum.

The following places were visited, and collections made from each: St. John, McCoy head, Gardner creek, Tynemouth creek, Little Lepreau, Moosehorn brook, Cape Enrage, Mary point, Grindstone island; Elgin, Albert county; Minto, Sunbury county; and Beersville, Kent county.

The work done at the localities examined last summer was briefly referred to in the Summary Report for 1908, p. 183. The new places visited this year are: Little Lepreau, Elgin, Minto, and Beersville. It is reported, locally, that many good specimens of fossil plants have been collected from Lepreau; and Bailey and Matthew give a list of about twenty species, named or described by Sir J. W. Dawson, from this locality.[1] As far as I have been able to determine, no plant remains have been collected at Elgin; but in the report for 1876-7, plant stems are mentioned as occurring in the vicinity.[2]

Considerable collections of fossil plants have been made by members of the Geological Survey staff, from the Carboniferous basin in which Minto and Beersville are situated. These fossils were examined and named, or described by Sir J. W. Dawson, who, in 1871, made a list of fifty-five species from Grand lake, Coal creek, Three-tree creek, etc.[3] In 1873, he made an additional list of thirteen species from Salmon river, Cork settlement, Douglas harbour, etc.[4] In the same year he published a 'Report on the Lower Carboniferous and Millstone Grit of Canada,' in which some New Brunswick species are described, and in which is a list of 176 species of 'Plants of the Middle and Upper Coal Formation' of Nova Scotia and New Brunswick; but he does not indicate the species found in the last-named Province. Besides the above, he published many articles on the plants of this region in various scientific publications, and in his Acadian Geology.

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1 Geol. Sur. Canada, Report of Progress, 1870-1, p. 177.
2 Geol. Sur. Canada, Report of Progress, 1876-7, p. 374.
3 Geol. Sur. Canada, Report of Progress, 1870-1, pp. 214-216.
4 Geol. Sur. Canada, Report of Progress, 1872-3, pp. 206-207.

Since returning from the field, there has been no opportunity to study the specimens collected. No definite statement can, therefore, be made as to what these fossils will show in regard to fixing the geological boundaries of the two formations under consideration.

St. John and Vicinity.—Part of a week was spent, in company with Mr. L. M. Lambe, collecting at the Suspension bridge, Drury cove, and Kennebecasis island. Mr. Lambe has reported on the material collected at the two first mentioned localities. At Duck cove, west of the Fern ledges, a small specimen of *Pseudobaieri McIntoshi* was found.

Gardner Creek.—At Gardner creek and McCoy head, a number of species were added to those obtained last year, together with better specimens of others. Many calamites, some of them closely resembling *C. suckovii*; three or four beautiful ferns of sphenopteris type, and slabs almost covered with a fruit like *Cardiocarpum* were secured. A large number of erect calamites were seen in the strata between Doctor brook and Gardner creek. At the mouth of Gardner creek, west side, a fruit of the Antholithes type was found well preserved.

Tynemouth Creek.—In 1908, a small collection was made at Tynemouth creek and vicinity, and this summer a more careful examination resulted in a most interesting lot of specimens. The rocks east of Tynemouth creek consist chiefly of reddish sandstone, with occasional grey beds and small layers of fine shale. The finer beds are interlaminated with the coarser all along the shore, and in almost every exposure yield plant remains; numerous pinnules, and small fronds of *Neuropteris, Pecopteris,* and *Alethopteris* were found, also a few *Cordaites* and *Calamites* and many good specimens of fruits. The fruits are well preserved in bright graphite, and seem to be of four species; *Cardiocarpum crampii,* or a closely allied species, being the most numerous. At Regan point, narrow ribbed *Calamites, Alethopteris* leaves, and fronds, numerous well preserved stems and stigmaria with attached rootlets were found.

Just east of Buckley point, a bed of dark, in places almost black, shale, about 16 inches thick, is full of shells of *Naiadites.* Some large slabs are literally covered with these fossils. The bed also holds fish scales, and plant stems; the latter spotted with spirorbis. East of Buckley point, *Calamites, Sigillaria,* and small pinnules of ferns were noted.

Little Lepreau.—At Little Lepreau, a small collection of plants was made. In general appearance, the rocks of this locality resemble those at the Fern ledges, St. John, and there are many species of plants recorded as common to both localities. Good specimens of an Alethopteris and an Annularia were got between the mouth of Little Lepreau river and Ragged head. Near Ragged head, on the farms of Dr. Reynolds and Mr. Boyne, specimens of detached *Neuropteris* leaves, showing the venation very clearly, were found; also *Pecopteris* fronds, an *Asterophyllites, Cardiocarpum crampii,* and many *Calamites* and *Cordaites.* At Ragged head there are large trunks of trees, silicified or pyritized.

Moosehorn Brook, Norton.—Collections were made from beds near the mouth of Moosehorn brook, and included *Lepidodendron corrugatum* with the leaves attached, small globular bodies, which seem identical with the spore-cases of this plant, as described by Sir J. W. Dawson, from Horton, N.S.;[1] and pinnules of an *Archæopteris* similar to those from Kennebecasis island and Elgin.

Cape Enrage.—The coast from Cape Enrage to Mary point was next examined. The rocks north of the lighthouse strike N 34° E, and are nearly vertical, rising sheer out of the water at high tide, forming cliffs over 100 feet high. The rock is mostly

[1] Report on the Fossil Plants of the Lower Carboniferous and Millstone Grit Formations of Canada, p. 20, pl. 2, fig. 22.

grey sandstone, full of coarse plant stems and flattened tree trunks. Interbedded with the sandstone are bands of conglomerate, which are mostly small and not always continuous, and, as everywhere along the coast, there are beds of very fine, friable shale, which weathers easily and leaves the harder rock standing out prominently, as at Squaw Cap. From these shales a good collection was secured, including *Calamites,* ferns, etc.

Mary Point and Grindstone Island.—Some interesting fossils were noted at Mary point, where ends of fossil tree trunks show. It is reported that in former years several good ferns were found in the sandstone quarry, but I was only able to secure a few pinnules. A day was spent on Grindstone island, where the rocks are similar to those on Mary point. Only a few plant stems and portions of a tree trunk were found.

Elgin, Albert County.—At Elgin, Albert county, part of a week was spent collecting from the shales on Robertson brook. Good specimens of *Lepidodendra;* a pinnule of a fern, like *Archæopteris;* and a large number of fish scales were obtained here.

Minto, Sunbury County.—Some of the coal mines at Minto were examined, and collections made from the shale removed with the coal. The best material comes from a very fine-grained, dark grey shale which lies above the coal, and from it a large collection of beautiful specimens was made. Among the specimens were *Lepidodendra* showing the leaf scars perfectly, *Calamites* with leaves attached, and a number of ferns in a very good state of preservation.

In the collection donated by Mr. Evans—referred to on a former page—there is a trunk of a sigillaria, 14 inches long and 12 inches wide; a stigmaria; and several species of ferns, all of which will make good museum specimens.

Beersville, Kent County.—At Beersville, a large number of specimens, similar to those at Minto, and occurring under the same conditions, were collected.

NATURAL HISTORY BRANCH.

(John Macoun.)

After the date of my last report, I worked until April 24, on the flora of Vancouver island and that of the Ottawa region: descriptions of both of which are in course of preparation. Office duties have so increased, that the correspondence now takes up a large share of my time and that of my assistant, Mr. J. M. Macoun.

Owing to our success last year in the collecting of natural history specimens in the vicinity of the Biological station at Departure bay, Nanaimo, B.C., and the necessity of collecting further material for the new Museum, the Director deemed it advisable that further collections should be made on Vancouver island. It was decided that Barclay sound and its vicinity was the best location in which to make collections of the marine fauna and flora. Accordingly, Mr. C. H. Young and the writer started for the west on April 24. At Vancouver, Mr. William Spreadborough—who has assisted the writer for many years—was engaged. A house at Ucluelet, on the north side of Barclay sound, kindly placed at our disposal by Mr. Sutton, was occupied during our stay there.

All the members of the party engaged in the collection of specimens: Mr. Spreadborough attended to the preparation of specimens in alcohol and formalin; while Mr. Young prepared the insects, crabs, starfish, etc. As the spring advanced, we extended our collecting grounds, and after the first month dredged in from 5 to 35 fathoms: obtaining a very large series of forms not found at low tide. When the whole of the collections are worked out, it is expected that much light will be thrown on the food of the cod, halibut, and salmon that swarm in these waters.

On August 19, I left by stage for Nanaimo, to visit the Biological station; Messrs. Young, and Spreadborough continuing the work at Ucluelet, until September 1, when we all met again in Victoria. Mr. Young then returned to Ottawa; Mr. Spreadborough completing the unfinished work in the vicinity of Victoria; while I joined the members of the British Association who were visiting the Pacific coast.

Below is given—in general terms—a synopsis of the collections made:—

Starfishes	400
Crabs, and shrimps	400
Fishes	100
Isopods	500
Tunicates, and ascidians	90
Sponges	250
Hydrozoa	150
Jelly-fishes	4
Shells	37,927
Insects	850
Birds	9
Mammals	2
Toads, etc	15
Seaworms	150
Seaurchins	50
Seaslugs	75
Barnacles	35

Polyzoa	45
Actinozoa (stony corals)	25
Sea-spiders	10
Anemones	15

Of plants, 1,008 species were collected, numbering many thousand specimens. The various families were represented as follows:—

Flowering plants	361
Mosses	226
Lichens	123
Liverworts	134
Seaweeds	164

Since my return from the field, Mr. Young, Mr. J. M. Macoun, and I have been engaged in sorting and naming the specimens collected, when routine work of the office did not otherwise claim our attention. Mr. Young has been working on the insects, and marine material; Mr. J. M. Macoun on birds and flowering plants, and myself on Cryptogams. The fish, decapods, isopods, starfish, and many of the plants, have already been sorted, and a number sent to specialists for confirmation of our determinations.

During the early months of the year much of the time of my assistant—Mr. James M. Macoun—was spent on the Catalogue of Canadian Birds, which is now published, and being distributed. Good progress was also made in the re-arrangement of the herbarium; in the distribution of specimens, and in the naming and mounting of botanical material. In the herbarium, 2,171 sheets of specimens have been placed; and 3,272 sheets distributed to museums and colleges. No record of the number of specimens named for correspondents was kept until the autumn of 1909; but 648 sheets have been so named since September 23, and 554 letters were written in connexion with our work. Besides her usual work as stenographer, Miss M. C. Stewart has done most of the labelling, and as time permitted, assisted in other ways in all branches of our work.

The Natural History specimens which have been acquired by purchase or otherwise since the death of Dr. Whiteaves, are:—

By presentation—

Saunders, W. E., London, Ont.:—

Two females of Mole (*Scalops aquaticus*)—Point Pelee, Ont.

Thirteen specimens of White-footed Mouse: four species; two males of *Peromyscus Bairdii*; two females and one male of *P. Americanus*; two males and one female of *P. Canadensis*; and four females and one male of *P. Michiganensis*, all from Point Pelee, Ont.

One Cardinal Bird—Point Pelee, Ont.

One Carolina Wren—Point Pelee, Ont.

Leach, W. W., Geological Survey, Ottawa:—

Skull of Lemming *(Lemmus helvolus)*, from head of Telkwa river, B.C., July, 1909.

Venner, Walter, Quebec, Que.:—

Brown Bat (*Vespertilio fuscus*), Parliament Buildings, Ottawa, February 24, 1909.

Bernier, Capt., Quebec, Que.

Barren Ground Caribou (*Rangifer arcticus*), Melville island.
Musk Ox (*Ovibos moschatus*), six skulls, Melville island.

MacMillan, G. R.:—

Skins of Great Northern Diver, White Gyrfalcon, and Snowy Owl; sex unknown; Melville island.

Questin, A. R., Carcross, Yukon:—

Male, female, and young of Dall's Mountain Sheep (*Ovis dalli*), Yukon mountains.

Porter, H. E., Whitehorse, Yukon:—

Male, female, and young of Moose (*Alce gigas*), from near Whitehorse.

Slack, J. H., Ottawa, Ont.:—

Gannet (*Sula bassana*): a young bird killed in October at Britannia, Ont.

MAPPING AND ENGRAVING.

(C. Omer Senécal.)

In April and May last, by request of the Director, competitive examinations for draughtsmen were held by the Civil Service Commission: Mr. James White, then Chief Geographer of the Department of the Interior, and the writer, acting as technical examiners. The best two draughtsmen were selected by the Commission, and appointed on the staff of the Geological Survey.

The personnel of this division at present consists of eleven members: namely, Messrs. G. C. Aitken, A. Dickison, J. O. Fortin, S. Jost, J. F. E. Johnston, H. Lefebvre, F. O'Farrell, O. E. Prud'homme, J. A. Robert, R. B. Yorston, and J. J. McGee.

The routine work includes the plotting of geographical projections; computation of astronomical observations; compilation of all kinds of maps, and the drawing and preparation of the same for engraving and publication; correction and revision of map proofs; making photographic reductions of maps, negatives, and prints; tracings and drawings of all descriptions for office and field use and general geographical work. Some 300 letters, memoranda, specification sheets, reports, etc., relating to the work of the division were sent out, while 260 were received.

Map Editions Published.

There are at present seven maps in the hands of the King's Printer, several of which will be issued shortly. A list of the editions received during the year 1909, is given below:—

1042 Dominion of Canada—Minerals—Scale 100 miles to 1 inch—Second edition.
1084 Dominion of Canada—Geology—Scale 100 miles to 1 inch.
1083 Western Canada—Geology—Scale 100 miles to 1 inch—Special edition, not intended for general distribution.
1041 Yukon Territory—Whitehorse Copper Belt—Geology—Scale 1 mile to 1 inch.
1026 Yukon Territory—Whitehorse Copper Belt—Geology of central portion—Scale 400 feet to 1 inch.
1044 Yukon Territory—Whitehorse Copper Belt—Surface at Arctic Chief mine—Scale 160 feet to 1 inch.
1045 Yukon Territory—Whitehorse Copper Belt—Grafter mine—Scale 20 feet to 1 inch.
1046 Yukon Territory—Whitehorse Copper Belt—Empress of India mineral claim—Scale 200 feet to 1 inch.
1047 Yukon Territory—Whitehorse Copper Belt—Surface at Copper King mine—Scale 400 feet to 1 inch.
1048 Yukon Territory—Whitehorse Copper Belt—Best Chance ore body—Scale 40 feet to 1 inch.
1049 Yukon Territory—Whitehorse Copper Belt—Surface at Pueblo mine—Scale 60 feet to 1 inch.
1002 British Columbia—Special map of Rossland, West Kootenay—Geological sheet—Scale 400 feet to 1 inch.
1004 British Columbia—Rossland Mining camp, West Kootenay—Geological sheet—Scale 1200 feet to 1 inch.

SESSIONAL PAPER No. 26

1074 British Columbia—Sheep Creek Mining camp, West Kootenay—Sketch topographical map—Scale 1 mile to 1 inch.

993 Northwestern Ontario—Explored routes between Lake Nipigon and Sturgeon lake—Scale 4 miles to 1 inch.

1061 Northwestern Ontario—Explored routes between Lake Minnitaki and Lake of the Woods—Scale 4 miles to 1 inch.

1023 Central Ontario—General geological map showing Corundum-bearing rocks—Scale about 18 miles to 1 inch.

1076 Northern Ontario—Gowganda Mining Division—District of Nipissing—Preliminary geological edition—Scale 1 mile to 1 inch.

1019 Nova Scotia—City of Halifax geological sheet, No. 68—Scale 1 mile to 1 inch.

1019a Nova Scotia—City of Halifax and vicinity—uncoloured—Scale 1 mile to 1 inch.

1025 Nova Scotia—Waverley geological sheet, No. 67, Halifax and Hants counties—Scale 1 mile to 1 inch.

1037 Nova Scotia—Windsor geological sheet, No. 73, Hants county—Scale 1 mile to 1 inch.

—— Nova Scotia—Ponhook Lake sheet, No. 72—Temporary edition, uncoloured—Scale 1 mile to 1 inch.

LIBRARY.

(Jane Alexander, Acting Librarian.)

Publications, to the number of 2,901, were received during the calendar year, as gifts or exchanges: including—besides periodicals—maps, reports, and publications of foreign Geological Surveys, together with memoirs, transactions, and proceedings of scientific societies of both Europe and America.

The number of volumes purchased was 99—costing $369.05; and 85 periodicals were subscribed for; while 325 volumes were bound.

Letters sent out relating to library work numbered 164; while 710 replies were received acknowledging the receipt of Geological Survey publications.

Bsides cataloguing current additions to the Library, more than 3,000 index cards have been re-written, filled up to date, and placed in the new catalogue drawers.

PUBLICATIONS.

The following Reports and Catalogues have been Published since January 1, 1909:—

No.

973 Catalogue of Canadian Birds. By J. Macoun. Published December 15, 1909.

980 Report on a Portion of Northwestern Ontario, in the Districts of Algoma and Thunder Bay. By W. J. Wilson. (Bound with No. 1081.) Published November 8, 1909.

996 Preliminary Report on a Portion of the Main Coast of British Columbia and Adjacent Islands (Second edition). By O. E. LeRoy. Published July 19, 1909.

1020 Contributions to Canadian Palæontology, Volume III (quarto), Part IV: The Vertebrata of the Oligocene of the Cypress Hills, Saskatchewan. By L. M. Lambe. Published March 26, 1909.

1035 Report on Coal Fields of Manitoba, Alberta, Saskatchewan, and Eastern British Columbia. By D. B. Dowling. Published October 15, 1909.

1050 Report on Whitehorse Copper Belt, Yukon. By R. G. McConnell. Published October 4, 1909.

1052 Report on Artesian Wells in the Island of Montreal. By F. D. Adams and O. E. LeRoy. *French translation.* Published October 28, 1909.

1072 Summary Report, 1908. Published May 4, 1909.

1073 Catalogue of Publications (1843-1909). Published October 4, 1909.

1075 Preliminary Report on Gowganda Mining Division, District of Nipissing, Ont. By W. H. Collins. Published May 22, 1909.

1081 Report on the Region lying North of Lake Superior, between the Pic and Nipigon Rivers, Ontario. By W. H. Collins. (Bound with No. 980.) Published November 8, 1909.

1085 A Descriptive Sketch of the Geology and Economic Minerals of Canada. By G. A. Young—with Introduction by R. W. Brock. Published November 2, 1909.

SPECIAL REPRINTS.

The Nepheline and Associated Alkali Syenites of Eastern Ontario. By Frank D. Adams and Alfred E. Barlow. Transactions of the Royal Society of Canada, Volume II, Section IV. Published August 14, 1909.

FRENCH TRANSLATIONS.

(M. Sauvalle.)

949a Report on the Cascade Coal Basin, Alberta. By D. B. Dowling. (Sess. Paper No. 26 C.) (Edited only.)

999 Preliminary Report on Gowganda Mining Division, District of Nipissing, Ont. By W. H. Collins.

1035a The Coal Fields of Manitoba, Saskatchewan, Alberta, and Eastern British Columbia. By D. B. Dowling.

1067 Report on the Geology and Physical Character of the Nastapoka Islands, Hudson Bay. By A. P. Low.

1114 Report on the Algoma and Thunder Bay Districts. By W. J. Wilson. (Bound with No. 1119.)

1119 Report on the Region lying North of Lake Superior, between the Pic and Nipigon Rivers. By W. H. Collins. (Bound with No. 1114.)

1124 Report on the Dominion Government Expedition to Hudson Bay and Arctic Islands. By A. P. Low.

DISTRIBUTION OF PUBLICATIONS.

During the past year, 76,681 publications—including reports, parts of reports, bulletins, maps, etc.—were distributed to libraries, scientific institutions, exchanges, and individual applicants: of these, 42,835 were distributed in Canada; 8,820 in the United States; 8,201 in England, and 11,825 in foreign countries.

The sale of publications during the year—December 1, 1908, to December 31, 1909—including maps and reports, amounted to $405.19.

The number of letters received in connexion with the distribution of maps and reports, was 5,174; besides 10,800 acknowledgments from exchanges and individuals. The number of letters sent out was 3,242.

ACCOUNTANT'S STATEMENT.

The staff of the Geological Survey, at present employed, numbers 70. During the calendar year the following changes in the staff have taken place:—

Deaths:—

J. F. Whiteaves.
Hugh Fletcher.

Appointments:—

A. S. Jost.
J. O. Fortin.
J. A. Dresser.
W. Malcolm.
M. Calhoun.

The funds available for the work and expenditure of the Geological Survey for the fiscal year ending March 31, 1909, were:—

Details.	Grant.	Expenditure.
Appropriations	$281,877 33	
Civil-list salaries	.....	$91,383 59
Explorations and surveys	.....	58,678 60
Experimental borings for gas, oil, etc	.....	14,656 65
Wages of temporary employes	.....	21,778 51
Printing, engraving, and lithographing	.....	42,559 43
Books and instruments	.....	6,888 39
Chemicals and apparatus	.....	22 81
Specimens for Museum	.....	6,520 92
Stationery, mapping materials, etc	.....	5,116 30
Ottawa Exhibition, 1908	.....	96 46
Incidental and other expenses	.....	7,288 32
Unexpended balance	.....	27,464 70
		$282,454 68
Less—Paid from appropriations 1907-8	.....	577 35
	$281,877 33	$281,877 33

(Signed) JNO. MARSHALL,
Accountant, Department of Mines.

GENERAL CONCLUSIONS.

A review of the foregoing reports will give point to the statement made in the introductory, that the work undertaken by the Survey is essentially practical and economic in character. While the needs of the miner and prospector must receive our chief consideration—since mining now ranks second only to agriculture among the national industries, and since intelligent and efficient mining must have as a foundation a sound knowledge of the geological conditions—still it has not been forgotten that it is the duty of the Survey, as a public institution, to collect and disseminate information of interest and value to the public in general.

The fields selected for investigation have been, almost without exception, those for which there has been a strongly expressed popular demand. On account of the limited staff, however, many areas that should have received attention have, perforce, been neglected.

To strengthen the field corps—especially in those cases where a specialist was required—I have not hesitated to enlist the services of foreign experts. This procedure has been justified by the results of the various investigations.

I have the honour to be, Sir,
Your obedient servant,

(Signed) R. W. BROCK.

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SUMMARY REPORT

OF THE

MINES BRANCH

OF THE

DEPARTMENT OF MINES

FOR THE CALENDAR YEAR ENDING DECEMBER 31

1909

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1910

[No. 26a—1910] No. 63

To His Excellency the Right Honourable Sir Albert Henry George, Earl Grey, Viscount Howick, Baron Grey of Howick, a Baronet, G.C.M.G., &c., &c., &c., Governor General of Canada.

MAY IT PLEASE YOUR EXCELLENCY:

The undersigned has the honour to lay before Your Excellency, in compliance with 6-7 Edward VII., Chapter 29, section 18, the Summary Report of the work of the Mines Branch of the Department of Mines during the calendar year ending December 31, 1909.

(Signed) W. TEMPLEMAN,
Minister of Mines.

Hon. Wm. Templeman,
Minister of Mines,
Ottawa.

Sir,—I have the honour to submit herewith, the Director's Summary Report of the work of the Mines Branch of the Department of Mines during the calendar year ending December 31, 1909.

I am, sir, your obedient servant,

(Signed) A. P. LOW,
Deputy Minister.

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SUMMARY REPORT

OF THE

MINES BRANCH OF THE DEPARTMENT OF MINES

FOR THE CALENDAR YEAR ENDING DECEMBER 31, 1909

A. P. Low, Esq., LL.D.,
Deputy Minister,
Department of Mines.

Sir,—I have the honour to submit, herewith, the Summary Report of the Mines Branch of the Department of Mines for the calendar year ending December 31, 1909.

CHANGES IN STAFF.

By Order-in-Council, dated June 2, 1909, Mr. W. W. Leach, technical officer of the Mines Branch, was re-transferred to the Geological Survey Branch.

Erik Nyström, technical officer, resigned March 31, 1909, to accept the position of Consulting Engineer to the Jern-kontorets, of Stockholm, Sweden; and on May 1, 1909, Dr. Alfred W. G. Wilson was appointed to fill the vacancy.

PROGRESS IN ELECTRO-METALLURGY.

ELECTRIC FURNACES FOR IRON ORE SMELTING AND STEEL MANUFACTURE.

The extraordinary rapidity with which electric furnaces for the production of steel have been developed and perfected since the publication of the Report[1] of the Commission appointed by the Dominion Government to investigate the Electro-thermic processes in Europe in 1904, will be appreciated when it is stated that only four electric furnaces of comparatively small capacity were then in existence in Europe; whereas in 1908—four years later—there were forty-six in operation, and thirty-one under construction.

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[1]Report of the Commission appointed to investigate the different Electro-Thermic Processes for the smelting of Iron Ores and the making of Steel, in operation in Europe. Mines Branch, Department of Mines, 1904.

The well-known technical journal *Stahl und Eisen*, Vol. XXVIII, 1908, gives the following tabulation of electric furnaces erected or in course of construction:—

PRESENT STATUS OF ELECTRIC STEEL INDUSTRY.

Works.	Charge.	Currents.	Size.
Induction Furnaces.	Kilograms.		Kilowatts.
Kjellin.			
Röchling Iron and Steel Works, Völklingen (Germany)	8 500	Single-phase	750
Fried. Krupp, A.-G., Essen (Germany)	8,500	"	750
Oberschlesische Eisenindustrie—A. G., Gleiwitz (Germany)	1,500	"	180
Pold hütte, Kladno (Bohemia)	4,000	"	440
J. Brauns' Söhne, Vöcklabruck (Austria)	400	"	65
Allg. Calcium carbide-Genossenschaft Gurtnellen (Switzerland)		"	330
Vidua de Urigoitia è Hijà Araya (Spain)	1,500	"	215
Alti Forni Gregorini, Lovere (Italy)	1,500	"	330
Eisenwerk Domnarfvet, Gysinge (Sweden)	1,500	"	175
Metallurgiska Aktiebolaget, Trollhättan (Sweden)	2,000	"	330
Vickers, Sons, & Maxim, Sheffield	550	"	150
Gröndal-Kjellin Co., Nine Elms Lane (London)	100	"	60
American Electric Furnace Co., Niagara Falls (U.S.A.)	800	"	150
" " "	100	"	60
Röchling-Rodenhauser.			
Röchling Iron and Steel Works, Völklingen (Germany)	3,500	"	400
" " "	8,500	"	750
" " "	2,000	3-phase	275
Bergische Stahlindustrie, Remscheid (Germany)	5,000	Single-phase	500
Le Gallais, Metz, & Co., Dommeldingen (Luxembourg)	700	"	100
" " "	3,500	"	300
" " "		"	300
" " "	1,500	3-phase	275
Aciéries Liégoises, Bressoux-les-Liège (Belgium)	1,000	"	200
J. Knöpfel, Walzenhausen (Switzerland)	1,000	"	175
Schneider.			
Schneider & Co., Creusot (France)	1,000	"	Experimental.
Schneider-Gin.			
Plettenberg (Germany)	4,500	Single-phase	400
Colby.			
H. Disston & Sons, Philadelphia (U.S.A.)	90	"	
Frick.			
Fried. Krupp, A.-G., Essen (Germany)	10,000		750
John Brown & Co., Sheffield	1,800		200
Wm. Jessop & Sons, Sheffield	3,000		450
A.-G. Electrometall, Ludvika (Sweden.)			
Arvika (Sweden)	1,000	3-phase	175
Hagfors (Sweden)	560	"	125
St. John del Rey Mining Co. (Brazil)	2,000	"	300
Arc Furnaces.			
Héroult.			
Edgar Allen & Co., Sheffield	3,000	Single-phase	
Stahlwerke Richard Lindenberg A.-G., Remscheid-Hasten, (Germany)	3,000	"	370
" " "	1,800	"	300
" " "	500	"	

SESSIONAL PAPER No. 26a

PRESENT STATUS OF ELECTRIC STEEL INDUSTRY—*Continued.*

Works.	Charge.	Currents.	Size.
ARC FURNACES—*Con.*	Kilograms.		Kilowatts.
Héroult—Con.			
Bismarckhütte, Bismarckhütte (Germany)	3,000	"	400
" "	1,000	"	260
Deutsch-Oesterreichische Mannesmann-Röhren-Werke, Burbach (Germany)	3,000	"	400
Deutsche-Mannesmann-Röhren-Werke, Saarbrücken (Germany)		"	
Danner & Co., Judenburg (Austria)	2,000	"	300
Gebr. Böhler & Cie., A. G., Kapfenberg (Austria)	2,500	"	350
Georg. Fischer, Schaffhausen (Switzerland)	1,000	"	250
" " "	5,000	"	250
" " "	5,000	"	250
Kaernthner Eisen & Stahl Werke (Austria)	5,000	"	765
Soc. Electromét Française, La Praz (France)	3,000	"	370
Acièries du Saut du Tarn, St. Juéry (France)	5,000	"	600
Aktiebolaget Héroults Electriska Stal, Kortfors (Sweden)	4,500	Single-phase	300
Halcomb & Co., Syracuse (U.S.A.)	5,000	"	
The Noble Electric Co., Baird (U.S.A.)	5,000	"	
The Firth Sterling Steel Co., McKeesport (U.S.A.)	10,000	"	
Società Tubi Mannesmann, Dalmine (Italy)	6,000	"	736
" "	6,000	"	736
Du Giffre.			
Soc. des Hauts-fourneaux et Forges, Allevard (France)	3,200	"	500
Girod.			
S. A. Electrométallurg. Procédés P. Girod, Ugine (France)	1,800	"	300
" "	2,000	"	300
" "	2,000	"	300
" "	8 to 10,000	"	1,200 kw., 4 electrodes.
" "	8 to 10,000	"	1,200 kw., 4 electrodes.
Oehler & Co., Aarau (Switzerland)	2,000	"	300
John Cockerill, Seraing (Belgium)	3 to 4,000	"	450
A. Stotz, Stuttgard-Kornwestheim (Germany)	2,000	"	300
Marrel Frères, Rive de Gier (France)		"	
Ternitzer Eisen-und Stahlwerke, Ternitz (Austria)		"	
Stassano.			
Bonner Fräserfabrik, G. m. b. H. Bonn (Germany)	1,000	3-phase	185
" "	1,000	"	185
Forni Termoelettrici Stassano, Turin (Italy)	5,000	"	750
" "	5,000	"	750
" "	900	"	180
" "	900	"	180
" "	900	"	80
" "	400	Single-phase	75
" "	400	"	75
Royal Arsenal, Turin (Italy)	700	3-phase	150
" "	700	"	150
Keller.			
Holtzer & Co., Unieux (France)	8,000		

Since 1904 a number of furnaces of the Héroult type—the resistance type of furnace—have been installed in the United States of America.

The development of the electric furnace for the production of pig iron has proceeded much more slowly, and it is only within the last eighteen months that a commercial furnace has been constructed and perfected by the Aktiebolaget Electro-Metall, Ludvika, Sweden. At the present time a 2,500 horse-power electric shaft furnace of this type is under construction at Trollhätten, under the auspices of the Jern-kontorets, of Sweden.

The impression has been created by news items which have appeared in European journals that the experimental stage in the electric smelting of iron ores has not yet been passed, and that the last mentioned furnace being erected by the Jern-kontorets is intended for further experimentation. The latest informaton relative to that furnace is announced in the *Affarsvarlden: Economiskveckorevv*, No. 77, November 25, 1909. RD 1425-6, as follows:—

ELECTRIC IRON SMELTING.[1]

> In consequence of the purchase made by the Iron-Office, of the Swedish patent that belonged to the Elektro Metal Company, Limited, and the plan of building electric furnaces at Trollhätten, as mentioned before in this paper, it has been represented in the press, and especially in German papers, as if it was meant to be an experimental furnace by which it should be ascertained whether the electric smelting process would prove to be practically and economically possible, or as if here was a question of first attempts. This is, however, not the case, for at the Domnarfvet iron works an electric machine of 700 h.p. on the 'Electrometal' principle has been in constant operation for some length of time, and from Mr. Yngstrom's report in 'the annals of the Iron-Office' it will be clearly seen that the problem of producing iron by electricity is solved practically as well as economically. The furnace that the Iron-Office resolved upon building should, therefore, not be considered as an experimental furnace, but as a plant to which any owner of iron works or mines may bring his ore for smelting and get it ascertained what quality of iron he will gain by the electric smelting method. Undoubtedly discoveries will at the same time be made in order to find out what further advantages the electric smelting process may have, compared with that of the coke furnace.

Advices received at the Mines Branch office show that the firm of Jens Orten Boving & Co., 9½ Union Court, Old Broad street, London, England, have acquired the patent rights for Mexico, United States, and Canada of the electric furnace (Domnarfvet resistance type) invented by the Aktiebolaget Electro-Metall. Ludvika, Sweden.

ELECTRIC FURNACES FOR THE REDUCTION OF SPELTER AND ZINC OXIDE.

SPELTER FURNACES.

In the Summary Report for 1908 I mentioned two electro-thermic processes for the production of spelter: namely, the plant at Trollhätten, Sweden, and the demonstation plant now being erected in London, England—both of which were invented by Dr. De Laval; but which differ in principle and in construction. Particulars have since been received describing a third process (invented by Messrs. Côte and Pierron,

[1] The English is that of the Journal.

France), which, it is claimed, is of special economic advantage in dealing with composite zinc-lead ores, since it effects a practically complete separation of the zinc from the lead. These processes are to be investigated, and the results, together with illustrated descriptions of the processes, published in a separate bulletin.

BISULPHITE PROCESS FOR THE TREATMENT OF REFRACTORY ZINC-LEAD-SILVER ORES, ETC.

On page 7 of my last report, reference was made to the chemical process invented by Messrs. Sulman and Picard, metallurgical chemists and assayers, 44 London Wall, London, England, and Dr. Hommel, for the treatment of zinc-lead-silver ores, etc., by means of which, it is claimed, all the zinc, lead, and silver in the ores can be saved.

A description of the process is in the possession of the Mines Branch; but until the experiments now being conducted in Swansea, South Wales, Great Britain, are completed, no public disclosure is permitted. Arrangements have been made, however, for the investigation of this chemical process and the subsequent publication of a report on its commercial feasibility.

AIR NITRATES BY ELECTRICITY.

In my Summary Report for 1907-8, reference was made to the experiments conducted in France by Müntz and Lainé in the production of nitre by the intensified nitrification of peat beds; for use in the manufacture of explosives and war ammunition. Further reference was also made to the approaching exhaustion of the Chilian nitrate beds, and to the advantages of establishing a nitrates industry in Canada; not only in the interests of agriculture—for the supply of fertilizers; but for the utilization of saltpetre in the manufacture of explosives. Since the publication of the foregoing suggestions, considerable progress has been made towards perfecting the process for producing nitrous oxide direct from the air by means of electricity. It has been demonstrated that wherever electric energy can be produced at about $4 to $5 per electric horse-power year, atmospheric nitrogen can be transformed economically into nitrates.

The following extract from the U.S.A. *Daily Consular and Trade Report,* January 19, 1910, shows that the Norwegians are fully alive to the resources of their country, and with commendable energy and enterprise are utilizing them to advantage:—

NITRATES IN NORWAY.

Erection of Large Works for its Manufacture in the Kingdom.

Supplementing previous articles in *Consular and Trade Reports* on the manufacture of air nitrates for fertilizer in Norway, Germany, and Niagara Falls, Canada, it is learned from British consular reports that the industry is undergoing rapid expansion in the first-named country, where nearly $15,000,000 will be invested. Though there are vast water-powers in the United States running to waste, which could be utilized to produce this article, nothing has yet been done in that line, although this country is buying annually $15.000,000 worth of Chilian nitrates. The British consul's report from Christiania reads:—

Up till now about $6,000,000 has been expended on the works at Notodden and Svaelgfos and the power stations under construction at Rjukan and Vamma. When all the works are completed, at the end of 1910, $14,600,000 will have been spent. A great point in connection with the development of this industry, is that the opportunity has now arisen of opening up several industries in connection with the manufacture of nitrates, such as nitric acid, nitrate of ammonia, nitrate of potash, also sodium nitrate, which last is already being manufactured.

The Nobel syndicate, in conjunction with the Birkeland and Eyde Company, is now concentrating the weak acids, with the assistance of the gas furnaces, to an acid of such percentage as to become an article of transport, and further opportunities have thus been opened for export trade, especially from works with water-power that are situated near the seaboard.

It is of interest to note that no coal is used in the production of saltpetre or other products here referred to. It is stated authoritatively that there is no probability for many years to come that the sale of saltpetre produced by the method practiced at the Notodden and Rjukanfos works will be disturbed by competition with Chili saltpetre on the question of price.

LARGE ANNUAL PRODUCTION.

When the Rjukan Falls works are fully completed, they and the Notodden works combined will represent 240,000 horse-power, with a production of saltpetre representing an export value of $6,164,000.

At some not very far distant time it is not improbable that the waterways and loughs between Skien and Notodden may be increased to such size as to allow sea-going vessels to load up at Notodden. Plans have already been worked out and are under consideration in connection therewith. At present everything has to be lightered to and from Skien.

The value of the output of nitrates in Norway in 1908, was about $536,000, and the total expenses amounted to $402,000.

The following are the companies that are producing, or will shortly produce, saltpetre from the air:—

(1) The North Hydro Elektrisk Kvaelstof Aktieselskab, Christiania, who are the owners of Notodden Saltpeterfabrikker, the power of which (35,000 h.p.) is supplied from the Svaelgfos. The capital of the company, which is French, is $7,890,000.

(2) The Vammafos (Vamma Falls) Company, whose saltpetre works are now under construction. This company is a separate company, but half of its shares are said to be owned by the Norsk Hydro Elektrisk Kvaelst of Aktieselskab; some of the preference shares are in the hands of Norwegians. The amount of capital can not be stated.

(3) Rjukanfos (Rfukan Falls) Company, whose saltpetre works are also in course of erection. The capital of the company, which is one-half French and the other half Scandinavian and German, is $3,376,800. This capital has been furnished by some of the shareholders of the Norsk Hydro Elektrisk Kvaelst of Aktieselskab and of the Kraft Aktieselskab, but the company is an independent one.

(4) The Mäter and Tyin waterfalls are owned by the Norsk Hydro Elektrisk Kvaelstof Aktieselskab and by the Kraft Aktieselskab, but the companies formed in connection with these falls are two separate companies with separate administrations. Electro-technical works will probably be erected at both of these falls.

(5) Khristianssands Elektrokemiske Aktieselskab, which is the property of the Badische Anilin und Soda Fabrik, Ludwigshafen, and has a capital of $53,600.

PLEA FOR A CANADIAN NITRATES INDUSTRY.

Canada imported only $698,608 worth of nitrate of soda in 1908; whereas the United States imports about $15,000,000 worth of Chilian nitrates annually to re-fertilize her exhausted agricultural lands. The reason for the comparative smallness of Canada's import trade in nitrates is explained by the fact that the prairie lands of the Dominion are covered with rich virgin soil, hence do not need replenishing with artificial fertilizers to any serious extent. In a few years, however, the law of diminishing returns will apply to Canada as seriously as it does to the United States. When that time arrives, nitrates will be greatly in demand in the agricultural regions of this country.

The farseeing nations of northwestern Europe are evidently preparing for a large export trade in artificial fertilizers, as the foregoing extracts from the British consular report shows. Perceiving that the guano beds of Peru, and the saltpetre beds of Chili are rapidly approaching exhaustion, they are straining every nerve to establish an immense nitrates industry.

But seeing that this country is almost prodigally furnished by nature with water-powers, from which electric energy can be developed at reasonable rates, there is no reason why a flourishing industry in the manufacture of air nitrates should not be established for supplying not only our own home market, but also the markets of the United States and the Orient.

ACCIDENTS IN MINES CAUSED BY EXPLOSIVES.

The number of accidents in mines and in other places where explosives are used has been increasing at an alarming rate in recent years. These accidents are due in part to a lack of knowledge of the nature and use of explosives and in part probably to defective manufacture. Early in 1909, steps were taken to gather comparative data and statistics for the purpose of studying the situation thoroughly. The first memorandum on the subject is dated June 27, 1909.

Only a brief epitome of the information collected can be given at this stage[1], but what is submitted will serve to show the serious need of a stringent code of laws regulating the sale and use of explosives.

Great Britain.

For a number of years the British government has carried on at Woolwich—under the Explosives Act of 1875 and amendments—investigations relative to the manufacture and use of explosives. Under this Act only explosives specified as 'Authorized' are allowed to be used in the United Kingdom. The expression 'authorized explosive' means exclusively an explosive defined in a list of authorized explosives signed by a government inspector and in force for the time being.

No manufacturer of powder or other explosive is allowed to sell, or put on the market any explosive which has not been tested in the Government station. The manufacturer has to submit both the final product and the component parts of all explosives for chemical and physical analysis.

---

[1] See Preliminary Report of J. G. S. Hudson.

The Government issues a printed list of all 'Permitted' explosives, together with the rules and regulations for their use. These regulations are rigidly enforced and no evasion is allowed. As a result of this wise provision, accidents due to the use of dynamite and other high explosives used in mining and blasting operations, have been greatly reduced.

During the year 1906, in one of the large English mining districts, not a single accident from explosives, or shot-firing was reported; in spite of the fact that 29 different kinds of explosives were used, and about 3,000,000 shots were fired, consuming 1,250,000 pounds of explosives.

United States.

In 1907, the death rate per 1,000 men employed in the coal mines of the United States, under the most favoured conditions, was 4·86. Dr. Joseph A. Holmes, chief of the technologic branch of the United States Geological Survey, states that 2,450 men lost their lives in coal mine accidents, during 1908. Since 1889, no less than 22,840 men were killed in coal mine accidents alone. Indeed, so serious was the state of affairs that in 1908 the federal government of the United States appointed a special commission, consisting of three foreign experts—Captain Desborough, who has charge of the United Kingdom testing station, being one of the number—to investigate the matter. They reported that the high percentage of mine accidents was in large part due to the unrestricted use of explosives.

On the recommendation of the above-mentioned Commission, the United States Government began at once to establish testing stations, the principal one being at Pittsburgh, Pa.

Canada.

In attempting to collect facts relating to accidents from explosives in Canada, the quest was found to be very unsatisfactory, since no centralized system for gathering such data is in existence. The Department of Labour tabulates all the facts available, but its information is largely derived from newspaper clippings; the Railway Commissioners obtained reports of accidents due to operation only, and not on construction; the Provincial governments record the accidents in mines, but not in any other class of work, and do not always obtain complete returns as to the number of employes and their occupations.

The following is a statement prepared by Mr. J. G. S. Hudson, of the loss of life in our coal and metalliferous mines during the interval 1899-1908.

In Canada the average for 10 years—1889 to 1908, per 1,000 men, was:—

British Columbia—
Coal mines ..... 9·21

Nova Scotia—
Coal mines ..... 2·67

British Columbia: 1908—
Metalliferous mines ..... 5·93

Ontario: 1907—[1]

Copper and nickel	2·19
Silver and iron	7·36

According to the Annual Report of the Ontario Bureau of Mines[2], in 1908 there were 13 fatal accidents underground in the silver producing mines of Cobalt. The published returns state that there were 1,089 men employed underground in these mines, so that the ratio for fatalities becomes 11·94 per 1,000 employes underground. There were also 14 fatal accidents underground in the non-producing mines, including several accidents in sinking shafts, but the number of men employed in these mines is not recorded. In addition, 3 fatal accidents above ground make a total of 30 fatal accidents in the Cobalt district. The total force employed, above and below ground, was between 3,500 and 4,000 men.

In England, the average loss of life in mines, per 1,000 men employed, during the years 1903 to 1907, was:—

Coal mines	1·29
Metalliferous mines	1·08

The greater number of fatalities in Canadian mines, as compared with those in Great Britain, is manifestly due to the enforcement of wise laws and regulations in the latter case, and to the utter absence of protective legislation in the former. Hence, with a view of providing a remedy, I have recommended that a central station —similar to those established in England and the United States—be built in Ottawa, for the testing of all explosives; and that an Explosive Act be passed effectively regulating the manufacture and sale of explosives, their use in mines, and in blasting operations generally.

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[1] Mines and Quarries Report for 1907; Part IV, Colonial and Foreign Statistics; page 296, Home Office, London, 1909.

[2] 18th Annual Report, pp. 14, 69, 70, and 94.

Table showing Fatal and Serious Accidents in the Coal Mines of British Columbia and Nova Scotia.

Year.	British Columbia. — Output of Coal in Tons.	British Columbia. — Number of Men Employed.	British Columbia. — Accidents.			British Columbia. — Ratio per 1,000 men employed.			Nova Scotia. — Output of Coal in Tons.	Nova Scotia. — Number of Men Employed.	Nova Scotia. — Accidents.			Nova Scotia. — Ratio per 1,000 men employed.			United Kingdom. — Fatal Accidents. — Ratio per 1,000 Men Employed.	United States. — Fatal Accidents. — Ratio per 1,000 Men Employed.
			Fatal.	Serious.	Slight.	Fatal.	Serious.	Slight.			Fatal.	Serious.	Slight.	Fatal.	Serious.	Slight.		
1899....	1,306,324	3,780	11	29	30	2·91	7·67	7·94	2,642,333	5,612	19	26	4	3·39	4·65	0·07	1·26	2·98
1900....	1,590,179	4,178	17	43	38	4·06	10·09	9·07	3,238,245	6,626	21	18	13	3·17	2·17	1·20	1·30	3·24
1901....	1,631,557	3,974	102	34	31	25·67	8·59	7·88	3,625,365	7,663	14	33	8	1·82	4·30	1·04	1·36	3·24
1902...	1,641,626	4,011	139	21	18	34 65	5·23	4 48	4,366,869	8,062	21	26	12	2·60	3·22	1·49	1·24	3·49
1903....	1,481,913	4,264	42	33	26	9·85	7·74	6·09	5,255,247	11,092	31	64	9	2·88	5·76	0·81	1·27	3·14
1904	1,685,698	4,453	37	41	16	8·31	9·20	3·59	5,247,135	11,659	27	55	33	2·40	4·71	2·83	1·24	3·38
1905....	1,825,832	4,407	12	30	26	2·72	7·03	5·90	5,050,420	10,780	20	55	19	1·85	5·10	1·76	1·35	3·53
1906....	1,899,076	4,805	15	36	32	3·12	7·49	6·66	5,866,605	12,123	29	58	16	2·39	4·79	1·32	1·29	3·40
1907....	2,219,608	6,059	31	61	62	5·11	10·06	10·23	5,720,660	12,107	37	59	22	3·05	4·87	1·81	1·32	4·86
1908....	2,109,387	6,095	18	50	52	2·95	8·20	8·53	6,299,282	12,933	45	97	82	3·48	7·50	6·34	1·32	3·55
	17,451,200	46,036	424	378	331	9·21	8·21	7·19	47,312,161	98,657	264	493	218	2·67	4·99	2·21	1·295	3·48

SESSIONAL PAPER No. 26a

GOVERNMENT PEAT BOG AT ALFRED, ONTARIO.

In my last Summary Report (page 8) the proposed government plant for the manufacture of air dried peat is described as an 'Experimental Peat-Fuel Plant.' The word 'experimental' should have been deleted, for the Anrep method of treating and preparing the peat for fuel purposes, has passed the experimental stage. In Russia and Sweden the system is an assured commercial success. The main objective, therefore, in establishing the plant at Alfred, is to demonstrate practical methods by which the country's immense resources of peat may be economically utilized as a substitute for coal.

It has been estimated that the known peat bogs of Canada, which are probably only a small fraction of the total, cover approximately, an area of 36,000 square miles, from which about 28,000,000,000 tons of air-dried peat could be produced. This would be equal in fuel value to about 14,000,000,000 tons of coal.

The comparative fuel value of peat, coal, and wood is: 1 ton of the best coal is equal to 1·8 tons of peat, or 2·5 tons of seasoned wood.

Realizing that in matters industrial it is good Canadian policy to begin where Europe left off, and armed with the practical knowledge gathered in an exhaustive study—on the spot—of the peat industry of northern Europe, the peat problem in Canada is being attacked systematically by the Mines Branch. Ten bogs have already been investigated, six of which are graphically described in Bulletin No. 1, published June 30, 1909, and now in its second edition. The others are referred to in Mr. Anrep's preliminary report, and will be fully described and mapped in Bulletin No. 2, to be issued shortly.

Conceiving that the most effective manner in which to awaken public interest in the ultilization of our peat resources would be the establishment of a plant on a commercial scale, equipped with the machinery and appliances which have been successfully used in European practice, a peat bog of 300 acres, with an average depth of 8 feet, was acquired by the Government, at Alfred, near Caledonia Springs, Prescott county, Ont. About five miles of ditches have been dug; a storage shed to hold 300 tons of air-dried peat, a blacksmith's shop, and an office, have been built. The following modern machines, etc., have been installed:—

Anrep peat machine, with conveyer, having a productive capacity of 25 to 30 tons of air-dried peat per day. A 35 horse-power steam engine and boiler combined; cable appliances for transporting peat about 1,200 feet; Jacobson field press; circular track for transporting dumping cars to field press—about 1,200 feet long; eight steel dumping cars, each 0·7 tons capacity; and about 2,500 feet of 600 mm. gauge field track has been laid.

This plant will be in active operation at the end of April, 1910, and interested parties may see for themselves the operations of a modern plant for the economic production of peat fuel.

FUEL TESTING STATION AT OTTAWA.

During the summer of 1909, a substantial brick building, suitable for equipment with modern fuel testing machinery and appliances, was built on Dolly Varden and Division streets, Ottawa. There is also a storage shed at the south end of the

lot capable of holding 150 tons of peat fuel. (See Plate II). The present installation consists of a Körting Peat Gas Producer, with the necessary cooler, scrubber, tar extractor, etc., a Körting 60 horse-power, 4 cycle gas engine; a Westinghouse 50 kw. dynamo—direct connected; and a portable resistance of 60 kw. capacity, for the purpose of absorbing the load when making tests; also a switchboard, with the necessary measuring and testing instruments.

The main building is divided longitudinally into two parts: one of which is occupied by the peat gas producer and its auxiliary apparatus—with office at the north end; while the other half is divided by a partition wall into two compartments: one being occupied by the gas engine and dynamo; the other reserved for an ore-dressing laboratory to be equipped with a 40 horse-power motor and concentrating machinery—the power for which is to be supplied by electric energy generated in the adjoining peat gas plant.

The gas generating room has been made large enough to accommodate other types of gas producers—specially designed for using bituminous coal or lignite, as fuel—which it is purposed to install in the near future.

The peat plant at Alfred has been installed under the supervision of Mr. A. Anrep, jr., of the Mines Branch staff; while the peat gas producer, with its auxiliary apparatus and machinery, has been installed—under the general supervision of Mr. B. F. Haanel, of the Mines Branch staff—by an expert sent by Körting Bros., from Hanover, Germany.

It is expected that the Fuel Testing Station will be in full operation and open for inspection by the general public by the end of April.

So many extravagant statements have appeared in the public press relative to the economic use of peat for domestic and power purposes, that it is necessary to reiterate and to emphasize the warning made before the Conservation Commission Convention at Ottawa, that the transportation to great distances of low-grade fuel—such as air-dried peat, is *not recommended,* either for domestic or for power purposes.

It is estimated that the expense of erecting a peat plant capable of producing 30 tons of air-dried peat daily should not exceed $7,000: and since workable peat bogs are scattered throughout the farming regions of Ontario and Quebec, the most economical plan for utilizing this fuel would be the erection of a number of plants at strategic points to be operated in the interests of the neighbouring communities.

PEAT BY-PRODUCTS: MOSS LITTER, AND PEAT MULL.

Not only is peat a valuable asset as a substitute for coal, but those classes of peat which are practically useless for fuel are extensively utilized by European farmers as moss litter. In fact, the manufacture of this litter, and its by-product 'peat-mull,' has become a well established industry in Sweden, Germany, and Holland.

Peat mull—obtained as a by-product in the manufacture of moss litter—is an excellent material for packing fruit and plants for storage and shipping. Its antiseptic properties and great affinity for moisture render it invaluable as a preventive of decay in fruit.

Peat Plant at Alfred, Prescott County, Ont.

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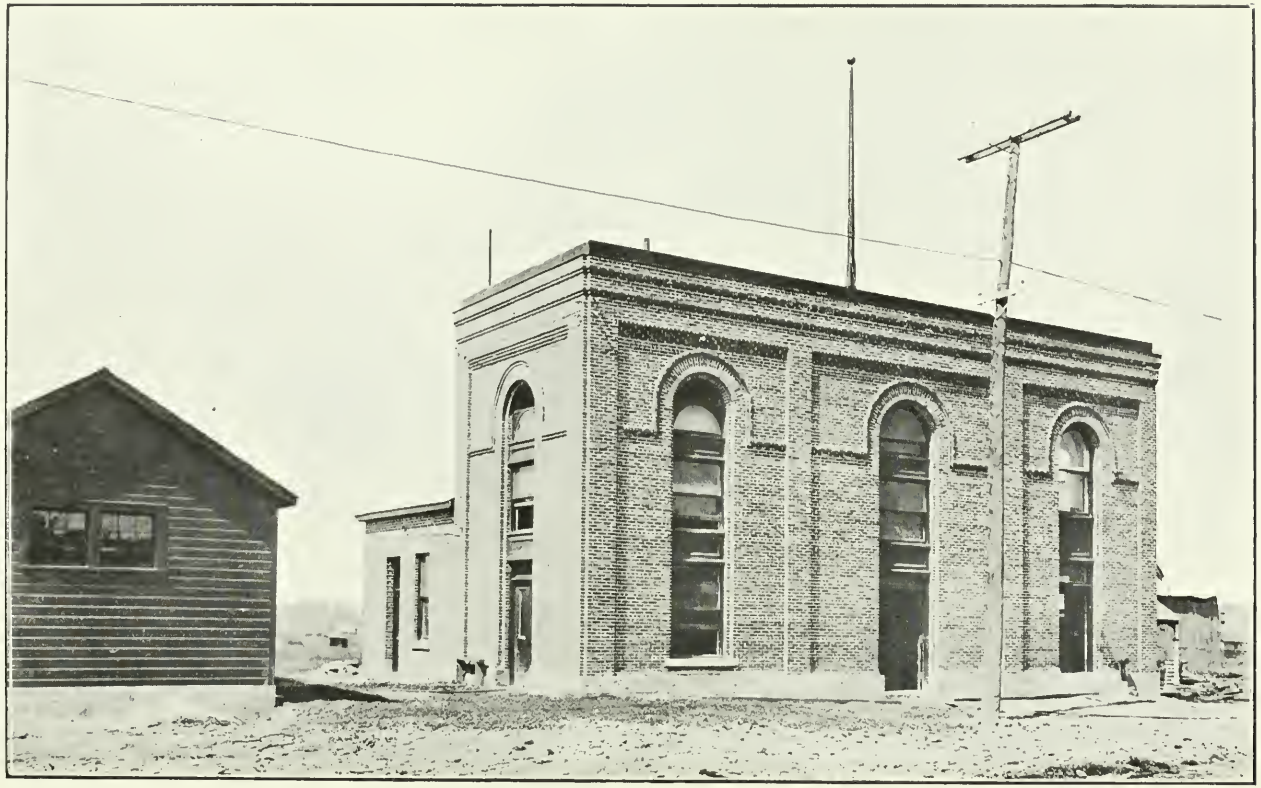

Fuel Testing Station, Ottawa.

In Norway some 200, and in Sweden between 300 and 400, small plants are in operation making this material; while in Germany and Holland—where there are a number of large plants—the manufacture of moss litter has become a flourishing industry. Most of the smaller plants are owned by groups of farmers, who work the bogs themselves.

Inasmuch as moss litter is—in many cases—a by-product in the making of peat fuel, its exploitation would materially reduce the cost of manufacturing peat fuel, if placed on the market commercially in conjunction with peat mull. Several shipments of moss litter from Holland have been made to the United States—at $16 per ton.

The different Departments of Agriculture in European countries very strongly urge farmers to use moss litter.

Seeing that Canada is fast becoming an important fruit exporting country, it is evident that the use of peat mull as a packing material would be a great economic advantage.

ON THE OIL-SHALE INDUSTRY.

Next to the electric smelting of iron ores and the solution of the peat fuel problem, no subject has evoked such commercial interest recently as the prospective supply of mineral oil from the bituminous shales found in various parts of the country—notably in New Brunswick and Nova Scotia.

New Market for Oil-fuel.

One ton of mineral oil is equivalent—as regards calorific value—to about two tons of coal, a fact which has led to its recent introduction as oil-fuel into the British navy.[1] This fact has also attracted considerable attention in the Maritime Provinces, especially in view of the prospective building of a Canadian navy. According to the report of Dr. Ells[2] the immense deposits of oil-bearing shales in eastern Canada are richer in hydrocarbons than the average Scotch shales, and in the manufacture of crude oil and sulphate of ammonia therefrom 'there would be a total gain over the Scotch shale of $3.73[3] per ton.

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1. 'Oil is likely to be a permanent form of fuel in the British Navy, and it is largely this fact that has given strength to the market. There is, of course, a wide difference between the actual purchase by the Admiralty and the potential consumption of the Navy. The actual annual production of the Scottish paraffin oil companies may be taken at from 150,000 to 200,000 tons per annum. The potential consumption of the British Navy may be considered to be about 1,500,000 tons per annum, on the basis of one ton of oil to two tons of coal, which is the equivalent usually considered to be correct. To supply the furnaces of such vessels as can burn oil-fuel quantities must be secured from abroad.

'Foreign Sources of Supply.

'The production of petroleum in the world is about 40,000,000 tons per annum; about 95 per cent is the output of foreign countries. The United States yield about 64 per cent of the whole; and then come Russia, with 22 per cent; Galicia, with 4·50 per cent; Roumania, with 3 per cent; Mexico, with 1·25 per cent, and so on. The proportions of the total supplied by British possessions are as follows:—India, about 2 per cent; Canada, about 0·20 per cent; Borneo, about 3 per cent; and Scotland and other places about 0·05 per cent. In plain English, we could not adopt oil as the sole fuel for our Navy without making large contracts for supplies with some foreign power or powers.' The *Times* (London), March 11, 1910.

2. Joint Report on the Bituminous, or Oil-shales of New Brunswick and Nova Scotia, also on the Oil-shale Industry of Scotland. Part I Economics, Part II Geology. By Dr. R. W. Ells, Mines Branch, Department of Mines, Ottawa, 1910.

3. Journal of the Mining Society of Nova Scotia, Vol. XV., February, 1910, p. 25.

From the foregoing facts it is manifest: (1) that Canada has extensive deposits of rich, oil-bearing shales; (2) that these oil-shale resources can be utilized for the manufacture of mineral oil and ammonium sulphate at a profit; and (3) that there is bound to be not only a large Canadian trade, but a larger profitable market within the empire.

Oil-shale Testing Laboratory.

To assist prospective operators of oil-shale works, the chemical laboratory of the Mines Branch at Ottawa has been equipped with modern chemical apparatus and the latest mechanical appliances for demonstrating practical methods of producing crude oil and sulphate of ammonia from oil-shales by destructive distillation. A detailed description of both methods and apparatus—written by Harold Leverin, Ch.E.—will be found in Appendix II.

MAGNETOMETRIC SURVEYS.

There is one special feature of Mines Branch work which is proving to be of increasing importance in the development of the mineral resources of the country, namely, *magnetometric surveying*. This system is described in my 'Report upon the Location and Examination of Magnetic Ore Bodies by Magnetometric Measurements,' published in 1904; and is explained popularly in Appendix IV.

For the last seven years, this method has been applied with increasing efficiency and success by members of my staff; and that the work is being appreciated is evident from the constant applications being made for special surveys. Moreover, it is interesting to note that the publication of our series of magnetometric survey maps is attracting attention abroad. The system was first applied in Sweden about the year 1879; but the work of the Department of Mines of the Canadian government, in formularizing the method into a coherent, practical system, is evoking appeals for Mines Branch literature[1] on the subject even from Sweden.

A special request has been received from the Technological Institute of Stockholm, Sweden, for copies of the report on Magnetometric Surveying, issued by the Mines Branch, to be introduced as a text-book; the Geological Commission of Finland has made urgent application for our series of magnetometric survey maps, which they purpose using as aids in the planning of their own survey work.

Early in 1908, Professor C. K. Leith, of the University of Wisconsin, applied for the services of one of our magnetometric surveyors to act as an instructor in the Swedish methods of magnetic surveying. In December, 1909, a similar application was made by Wm. B. Phillips, Director of the Bureau of Economic Geology of the University of Texas. In November, 1909, an experimental table and equipment was installed in Queen's University, Kingston, and Mr. E. Lindeman, of my staff, delivered a short course of lectures on the Swedish methods of magnetometric surveying to advanced engineering students in Kingston. Mr. Lindeman also gave experimental demonstrations of the application of these methods of surveying. This is an event of considerable importance, especially in view of the coming development of our

[1] Report on the Location and Examination of Magnetic Ore Bodies by Magnetometric Measurements. Dr. Eugene Haanel, Mines Branch, Department of Mines, Ottawa.

magnetic iron ore resources, and the lectures and demonstrations should be of practical interest and value to the mining engineering students. As stated in my report[1] of 1904, p. 98:—

> Without such an experimental knowledge gained in the laboratory, and relying simply upon his theoretical knowledge of the subject, the observer will often, after having plotted his observations and drawn his curves, find himself unable to arrive at sound conclusions regarding the limit and distribution of the ore bodies in any complex case. It is for these reasons strongly recommended that mining schools—which desire to take up this subject as part of their curriculum —should provide every facility to their students to render themselves competent, by extended laboratory work, to undertake magnetic surveys, and enable them to correctly interpret the results of their measurements.

CHEMICAL LABORATORIES.

On account of the increased activity of the Department of Mines, and on account of the large amount of work required by private parties—which latter could not be unduly delayed, since cash for payment of the analyses must always accompany their requests—the chemists of the Mines Branch have not been able to overtake the work; hence to prevent the holding back of reports, it has been necessary to send out work for the Department, to outside chemists. Based on the facts stated, the plea made by Mr. Wait, in his report, for an increase of staff in the Chemical Division, has my earnest endorsation.

During the year the Wellington Street laboratory has been equipped with apparatus and appliances for the destructive distillation of oil-shales, and the determination of ammonium sulphate, as a by-product.

As announced in last year's summary of work done, a detailed report of analyses of ores, non-metallic minerals, fuels, etc., made in the chemical laboratories during the years 1906, 1907, and 1908, has been prepared. It is now passing through the press, and will soon be available for distribution.

DIVISION OF MINERAL RESOURCES AND STATISTICS.

The work of this Division, which comprises the collection of statistics of mining and metallurgical production throughout Canada, and the collection and recording of information respecting the country's mineral resources, has been carried on during 1909 with commendable activity, and a number of important statistical bulletins have been published.

These include:—

No. 31.—The Production of Cement in Canada during the calendar year 1908.

No. 44.—The Production of Asbestos in Canada during the calendar years 1907 and 1908.

No. 43.—The Production of Chromite in Canada during the calendar years 1907 and 1908.

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1. Report on the Location and Examination of Magnetic Ore Deposits by Magnetometric Measurements, by Dr. Eugene Haanel, 1904. Mines Branch, Department of Mines, Ottawa.

No. 42.—The Production of Iron and Steel in Canada during the calendar years 1907 and 1908.

No. 45.—The Production of Coal, Coke, and Peat in Canada during the calendar years 1907 and 1908.

No. 46.—The Production of Natural Gas and Petroleum during the calendar years 1907 and 1908.

The complete report on the mineral production during 1907 and 1908 was sent to the press in December. The arrears of work in respect of publication of reports which had accumulated in this Division as a result of a decrease in staff, occasioned by the transfer of the Division from the Geological Survey to the Mines Branch, is now being rapidly cleared up. Mr. J. M. Casey was appointed as assistant in the Division in June, and provision has been made for an additional appointment during the coming year.

The rapid growth of the mineral industry is shown in Mr. McLeish's preliminary report for 1909. The production during the past year exceeds $90,000,000 in value, and is the largest production that has been recorded in Canadian mining industry. Statistical information regarding this growing mineral development, to be of the utmost value, should be published at the earliest possible moment, and the policy of publishing advance bulletins as the information becomes available, which was begun in 1909, will be continued during the coming year.

A preliminary review of the mineral production during the year is included in the report of the work of the Division.

It is very satisfactory to note the growth of Canadian metallurgical industries, although there is still room for further development in the home treatment not only of our metals, but also of our non-metallic products. A large iron and steel industry has grown up in eastern Canada, with an annual output of over 750,000 tons of pig iron and about an equal amount of steel ingots and castings. The lead is now nearly all produced as refined pig lead; over 25 per cent of the copper is produced as blister, and the greater part of the balance as matte. Over 55 per cent of the silver production is fine metal and fine silver bullion, while nickel is nearly all produced as Bessemer matte.

At the Trail smelter and refinery in British Columbia, in addition to refined silver and lead, there is produced refined gold, refined antimony, babbit metal, and copper sulphate. In Ontario, white arsenic, in addition to refined silver, is being recovered from the Cobalt District ores treated at Copper Cliff, Deloro, and Thorold. Cobalt oxide is being recovered at Thorold and preparations are being made for the recovery of this metal at Deloro.

A preliminary report, or statistical review of the mineral production of Canada in 1909, will be found as an appendix to this report.

DOMINION OF CANADA ASSAY OFFICE.

During the calendar year ending December 31, 1909, 48,478·60 ounces of gold bullion, valued at $789,267.96, were received and assayed. These deposits were derived from the following sources:—

Source.	Deposits.	Weights.		Value.
		Before melting.	After melting.	
	No.	Ozs.	Ozs.	$ cts.
Yukon	81	5,130·36	5,003·12	83,870 84
British Columbia	458	36,708·91	35,970·03	602,530 77
Alberta	6	60·99	41·74	766 77
Alaska	27	6,552·33	6,535·49	101,605 49
California	1	26·01	25·89	494 09
	573	48,478·60	47,576·27	789,267 96

Weight before melting	48,478·60	ounces.
Weight after melting	47,576·27	"
Loss by melting	902·33	"

Loss percentage by melting =1·86127.

The earnings of the Assay Office, as shown by the Accountant's statement on another page, were $1,626.45 for the year.

Diversion of Canadian Gold to the United States.

According to the official report of Mr. G. Middleton—manager of the Vancouver Assay Office (p. 41), there has been a substantial increase of gold output in the Yukon during the year 1909, as compared with 1908; but that very little of this was marketed at the Vancouver office: the decrease in 1909, as compared with 1908, being 57,142·79 troy ounces. It appears that the greater part of the Yukon gold output is now shipped direct to San Francisco by registered mail, the transportation charges from Dawson, Y.T., to San Francisco being the same as from Dawson to Vancouver, B.C. A contributing cause of this diversion of Yukon gold to the United States is the important fact that, the charge imposed in the United States Mint, San Francisco, in the purchase of gold bullion, is one-eight of one per cent less on the gross value of the bullion than at the Vancouver office.

New Quarters for Assay Office.

For several years past, I have made an annual plea for the erection of a government-owned assay office building in Vancouver, instead of renting a private building, the rent of which has increased 125 per cent in seven years. Fortunately, the expiration of our lease occurred on December 1, 1909, at the same time that the old post-office building on Granville and Pender streets, Vancouver—a centrally located, well-built structure, of commanding appearance—was to be vacated for more commodious quarters, and since the ground floor and basement were found to be admirably adapted

for the purposes of the Assay Office, application was made by the Honourable the Minister of Mines to the Hon. Wm. Pugsley, Minister of Public Works, Ottawa, who placed part of the old post-office at the disposal of the Mines Branch. Seeing, however, that considerable alteration and changes in the building were necessary in order to accommodate the various departments of the Assay Office, and that this would take several months to accomplish, it was perceived that only two courses were open: either to close the Assay Office for three months, or to extend the lease of the existing Assay Office building. The latter course was decided upon, and the lease extended for three months, terminating April 30, 1910, at a rental of $300 per month—an increase of $75 per month.

It is now expected that on May 1, 1910, the Dominion of Canada Assay Office in Vancouver will be firmly established in an admirably adapted, centrally located, government-owned building.

SCOPE OF INVESTIGATIONS IN THE FIELD.

The general field work of the past season consisted of investigations of occurrences of iron ore, manganese, nickel, and molybdenum in the Provinces of Ontario, Quebec, and Nova Scotia; of the copper and sulphur mining industry in the Province of Quebec, the gypsum industry in New Brunswick and Nova Scotia; and the coal mining industry of Nova Scotia; together with the collection of additional data for the preparation of a second edition of the monograph on asbestos.

The field work in connexion with the investigation of peat consisted in the development of the government peat bog at Alfred, and detailed surveys of several other peat bogs in Ontario.

In addition to the above, the work on coal testing begun at McGill University in 1906 was continued; and laboratory experiments in the concentration of nickeliferous pyrrhotite were carried on in the ore dressing laboratories of Queen's University.

FIELD WORK.

The following is a brief epitome of the work done by the respective field officers:—

Dr. J. E. Woodman continued his investigation of the iron ore occurrences, and limestone deposits of Nova Scotia, with a view to incorporating the additional data in Part II of his report on the 'Iron Ore Deposits of Nova Scotia'—Part I of which was published July 5, 1909.

Mr. Einar Lindeman was occupied during the first part of the summer in making a magnetic survey of some mining locations on the iron range along the northeast arm of Lake Timagami—the Mines Branch having been petitioned to undertake this work. During the last three months of the field season, Mr. Lindeman made a detailed topographic and magnetic survey of the Bristol iron mine in the Province of Quebec. This work was undertaken in view of the proposed inauguration of electric smelting at the Chats falls; and results of the investigation furnish another demonstration of the utility of magnetometric surveys, since they indicate the presence of two magnetite deposits of considerable importance at only a short dis-

tance east of the place where the principal mining operations were carried on some twenty years ago. The details of the magnetic survey of the Bristol mine will be published as a separate bulletin: accompanied by magnetometric and topographic maps Nos. 60 and 61.

Mr. Howells Fréchette was engaged from June 1 to October 15, 1909, in the examination of iron ore deposits in central and northeastern Ontario.

In Mayo township, Hastings county, the survey of the Rankin and Child properties—which was unfinished at the close of the season of 1908—was completed.

Deposits were investigated, and ore zones traced in Darling township, Lanark county; Bagot and Blithfield townships, Renfrew county; and South Canonto township, Frontenac county. In this section, the iron ore deposits visited were found to be, in most cases, small, and in several instances merely local enrichments of the country rock with magnetite. He is of opinion that, some of the latter deposits might be workable, but would require magnetic concentration.

Mr. B. F. Haanel examined—during the summer—some of the most prominent iron mines and prospects along the Central Ontario railway; the Chaffey and Matthews iron mines near Newboro on the Rideau lakes, Province of Ontario; occurrences of iron ore in the counties of Ham and Megantic, Province of Quebec; an occurrence of hematite and magnetite in the vicinity of Gaspereau station on the Canadian Pacific railway, Province of New Brunswick; and an occurrence of titaniferous magnetite near Namegos, a station on the Canadian Pacific railway, Province of Ontario.

Besides this work, Mr. Haanel spent a considerable part of the year in Ottawa, supervising the erection of the fuel testing station, and in the preparation of the report on the electric shaft furnace at Domnarfvet, Sweden. In addition, he investigated a process in Newark, N.J., U.S.A., for the making of gas for power and illuminating purposes from raw peat.

Dr. A. W. G. Wilson spent the summer season studying the present status of the copper mining industry in the Province of Quebec. It appears that at the present time only one mine is shipping ore, namely, the Eustis mine at Eustis, Quebec, all the rest having been either abandoned or having ceased operations. In the course of his investigations Dr. Wilson visited all the known prospects in the Province, and his general conclusion—based upon personal inspection—is, that very few of the abandoned mines or prospects ever contained ore in commercial quantities: most of the deposits consisted of small pockets, which were soon exhausted. Even in those places where the geological indications warranted careful examination, the prospecting had been so manifestly unsystematic, and the methods of exploitation so crude and wasteful, that financial failure was the inevitable result. Dr. Wilson's view with regard to the future of the copper mining industry in Quebec is, that owing to the lack of a suitable, nearby market, and to high transportation charges, only the richer ores can be mined at a profit; and then, only by co-operation between the proprietors of a centrally located smelter and the owners of copper mines.

While in the Eastern Townships Dr. Wilson visited the abandoned antimony mine in South Ham, also a newly discovered locality in the township of Spalding, where

iron ores were said to occur, and incidentally, two localities at which newly discovered talc deposits had been reported, were visited. A statement of the conditions at these several localities will be found on pages 76 and 77 of his summary report.

During the month of December, Dr. Wilson visited the Provinces of New Brunswick and Nova Scotia, for the purpose of planning next season's work in connexion with the investigation of the occurrences of copper ores in Canada generally.

Mr. Theo. C. Denis was entrusted with an examination of the manganese ore deposits which formerly were actively worked in the Maritime Provinces, with a view to investigating the causes which led to their abandonment. It was thought that some of the mines might be re-opened as a source of manganese for the steel industry in Canada and in the United States; but Mr. Denis is of opinion that these deposits could not be worked economically enough to enable Canadian producers to compete with the manganese ores mined in Russia, India, and Brazil. The Canadian ores of manganese are, however, of exceptional purity, and would probably bring higher prices than the ores now used in the iron and steel industry.

In addition to this work, Mr. Denis spent much time writing and revising a report on the coal fields and coal mines of Canada. This report is intended as a popular description of the coal resources and coal industry of Canada; and is to accompany the report on the coal tests now being prepared under the auspices of the Mines Branch.

Mr. Denis also prepared, at my request, numerous notes and memoranda of a technical nature, in answer to inquiries concerning mineral deposits, mining operations, etc.

Mr. W. F. Jennison continued his work of investigating the gypsum resources of Nova Scotia and New Brunswick; and in addition, examined the deposits on the Magdalen islands in the Gulf of St. Lawrence. In the early part of the year he visited the districts in the United States where gypsum is manufactured into plaster of Paris, stucco, cement plaster, flooring plaster, alabaster ornaments, fertilizer, etc. Judging by the data incorporated in his preliminary report on page 89, his detailed report, now in preparation, should be a comprehensive and valuable addition to the growing series of Mines Branch publications on the economic minerals of the country.

Dr. T. L. Walker—carrying out the project announced in my last summary report—spent two months of last summer investigating the occurrence of molybdenum ores in Canada. The chief commercial value of molybdenum consists in its utilization as an ingredient of high grade tool steel and of magnet steel. By the addition of molybdenum, steel is enabled to retain its temper when heated to a comparatively high temperature. In addition to his investigations in Nova Scotia, New Brunswick, and Quebec, Dr. Walker visited the molybdenum fields in Maine, United States, where he not only studied the occurrences of the ore, but inspected the methods of quarrying, crushing, and dry concentration. The data gathered are to be incorporated in an illustrated monograph on the subject.

Mr. G. C. Mackenzie, B.Sc., on September 22, 1909, commenced to gather typical samples of magnetic iron ores, high in sulphur, from the Bristol mines, situated in the township of Bristol, Pontiac county, Quebec; and similar, but more siliceous

merchantable iron ores from the Bathurst mines, situated in the township of Bathurst, Gloucester county, New Brunswick. These, he subsequently analysed, and subjected to concentration tests: crushing, grinding, classifying, and magnetic separation—by both wet and dry methods—in the mining laboratory of the School of Mining, Kingston, Ontario, temporarily rented for the purpose.

In addition to the foregoing experiments on magnetic iron ores, Mr. Mackenzie, in November, began concentration tests with selected nickeliferous pyrrhotites. The results of the respective chemical analyses, together with tabulated statements showing the various concentration tests, are to be found in his preliminary report on page 54.

Mr. Fritz Cirkel, in 1909, continued his study of the asbestos region of Quebec. One important work achieved was the delimitation of the exact position of the continuation of the Serpentine belt in the township of Thetford with that of the adjoining Thetford-Black Lake area. The early part of the year was devoted to plotting his survey of the Broughton Serpentine range; while the summer season was spent inspecting the alleged discoveries of asbestos deposits of magnitude in the township of Thetford. His conclusion with regard to these prospects is that not one of the newly-discovered deposits is of sufficient extent or quality to warrant exploitation; and that only in ranges IV and V of that township are the deposits of commercial value.

Mr. Cirkel's preliminary report (page 107) indicates that since September, 1908, the production of asbestos has increased at the rate of 189·20 tons of mill fibre, daily. The second edition of his monograph on 'Asbestos: Its Occurrence, Exploitation, and Uses'—issued in 1905, is now being edited, and will be published in 1910.

Mr. A. Anrep was engaged during the greater part of 1909 superintending the installation of the government peat plant, and draining the bog at Alfred, Prescott county, Ontario. In addition to this work he investigated four peat bogs in the Province of Ontario, and prepared data for maps of these beds. His results will be incorporated in Bulletin No. 2 of 'Investigations of the Peat Bogs, and Peat Fuel Industry of Canada,' to be issued by the Mines Branch in the near future.

Mr. J. G. S. Hudson was employed in the collection and preparation of material for his report on 'Coal Mining in Nova Scotia.' He also gathered information with respect to explosives, their nature and uses, and has been engaged in compiling statistics with reference to accidents in mines.

GENERAL CONSIDERATIONS.

A general glance over the work outlined in the preceding pages shows that the activities of the Mines Branch have been expanding rapidly, and that new lines of investigations are being started. The most important investigations now being made are (1) the experiments at the Alfred Peat Plant: for the purpose of demonstrating the practicability of economically manufacturing air-dried peat; (2) the demonstrations at the Fuel Testing Station, Ottawa: to show that air-dried peat, and other comparatively low-grade fuels can be utilized economically for power purposes; and (3) the systematic inquiry into the electro-metallurgy of zinc. Special monographs have

already been published on mica, asbestos, graphite, peat and lignite, tungsten, and chrome iron ore; and others on gypsum, building materials and ornamental stones, molybdenum, copper, etc., are in course of preparation. In addition to this special work, important reports on the iron ore resources of the various Provinces—such as Dr. Woodman's on "Iron Ore Deposits of Nova Scotia"—published during 1909—have already been issued; and others are now being prepared. So great has been the demand for certain of the monographs on the economic minerals of the country—particularly asbestos, mica, and peat—that our stock has been completely exhausted; necessitating the issuance of second editions. And a like condition of things prevails with regard to the reports on the smelting of iron ores by the electro-thermic process. A second edition of the report on the Domnarfvet Electric Shaft Furnace was called for, and issued in December, 1909—four months after its publication. Over 35,000 copies of monographs, reports, and bulletins were distributed through the post-office during the year.

The rapid expansion of the mineral industry, now taking place in Canada, is evidenced by the fact that, the total value of mineral products for the year 1909 was $90,415,763—being second in value only to agriculture. The correspondence in the Statistical Division, alone, amounted to 6,752 letters received and sent; while the correspondence in my own office amounted to 5,491 communications received, and 4,198 sent out.

I have the honour to be, sir,
Your obedient servant,

(Signed) EUGENE HAANEL,
Director of Mines.

REPORTS

ON

FUEL TESTING, CHEMICAL LABORATORIES, STATISTICAL DIVISION, AND ASSAY OFFICE.

COAL TESTS AT McGILL UNIVERSITY.

Dr. John Bonsall Porter.

The coal tests begun in 1907 have been completed, and the report setting forth the results is now being prepared for the press. It is not yet possible to give any detailed information as to the results of the test, but the following general statement of the character and scope of the work may properly be included in the Summary Report of the Mines Branch.

In the autumn of 1906 the Canadian Government decided to undertake a study of the fuels of the Dominion, somewhat on the lines of the 'Fuel Tests' which had already been commenced by the United States Geological Survey. The Government had not at Ottawa any suitable mechanical laboratories, and as Dr. Porter and Prof. Durley had already done some research work at McGill University on a number of western coals, the Honourable the Minister of Mines asked them to undertake a general investigation of Canadian coals. An arrangement was, therefore, made between the Government and the University, whereby the former undertook to pay for such apparatus and staff as were needed to supplement the testing equipment which the University placed at the disposal of the Government. The Intercolonial and Canadian Pacific railways very generously agreed to handle the material—amounting to many hundreds of tons—free of charge.

In the beginning it was intended to confine the investigation to the coals and lignites of the Dominion, and, owing to limited means, the following points only were covered by the scheme:—

(*a*) Sampling in the field.
(*b*) Crushing and preparing the samples for treatment.
(*c*) Washing and mechanical purification.
(*d*) Boiler trials.
(*e*) Producer trials.
(*f*) Coking trials.
(*g*) Chemical laboratory work

During the progress of the above work, the Department of Mines was organized, and the general supervision transferred from the Geological Survey to the Mines Branch. While there has been no change in the arrangements outlined, an additional investigation has been initiated by Dr. Eugene Haanel, Director of Mines, who has undertaken an exhaustive study of the peat deposits of Quebec and Ontario, and has commenced the erection at Ottawa of a peat fuel testing station. The immediate necessity of this second investigation will be realized when it is stated that no coal fields of importance occur in Canada between eastern New Brunswick

in the east, and Saskatchewan and western Manitoba in the west—a distance of over 2,000 miles; while throughout this great coalless territory there are numerous, and very extensive bodies of peat, which are all, as yet, wholly undeveloped. Seeing, however, that the investigation of peat is being conducted by the Mines Branch, directly, it is unnecessary to deal further with it here.

Canada possesses a number of coal fields which may be grouped, roughly, into four great divisions: three of which are of present importance.

(1) *The Maritime Provinces:—*

Nova Scotia and New Brunswick—

Bituminous coal only.. .. .. ..10,000,000,000 tons estimated.

(2) *The Central Plains and the Eastern Rocky Mountains:—*

Manitoba, Saskatchewan, Alberta, British Columbia—

Anthracite..	400,000,000	tons estimated.
Bituminous..	80,000,000,000	"
Lignite..	80,000,000,000	"

(3) *The Pacific Coast, and the Western Mountains:—*

British Columbia and the Yukon—

Anthracite..	10,000,000	tons estimated.
Bituminous..	2,000,000,000	"
Lignite..	1,000,000,000	"

(4) *The Arctic-Mackenzie Basin:—*

Lignite only.. .. .. 500,000,000 tons estimated.

In addition to the above, there are certain small fields—notably one in Ontario—of no present interest, containing some millions of tons of lignitic peat, and others of doubtful extent and value in the far north.

The coals of section (1)—Nova Scotia—are similar to the ordinary grades of English and Scotch coal; although in the average they may have a little more ash, and considerably more sulphur than the British seams of the same thickness. Most of them make fair coke, and on the whole may be taken as being fair to good steam coals, and excellent for domestic use. These coals are largely exploited, and, at present, provide the largest part of Canada's supply.

The coals of section (2) are enormous in quantity, and many of them excellent in quality: some of the best Crowsnest coals being admirable in every respect. These coals are, however, all of comparatively recent age geologically (Cretaceous), and, with the exception of the lignites, which occur chiefly in the plains, they are found in the main uplift of the Rocky mountains, in beds much tilted, and often very irregular. The coals are, consequently, less uniform in quality than they would otherwise be, and many of them carry large quantities of ash, either inherent, or, as an unavoidable admixture from mining operations.

These coals are largely exploited: the anthracite by the Canadian Pacific railway near Banff; the bituminous coals, by many companies, most of which are operating in the neighbourhood of the Crows Nest Pass branch of the Canadian Pacific railway; the lignites in numerous places in southern Alberta, and near Edmonton; also at many points in Saskatchewan and Manitoba.

The bituminous coals are, as stated above, very variable: ranging from very high grade steam coals, down. Some of these coals make admirable coke, others will do so if first washed free from their excessive impurities; others do not coke well or at all, but are useful for steam and domestic purposes. Others—and this includes the greater part—are still unexploited, and lie to the north of present lines of traffic; but all, or nearly all, are where they can easily be made available as the country becomes settled.

The western coast coals are best developed in Vancouver island, where they have been mined for many years, also in Graham island to the north, where mining has not yet begun; but smaller, although important, fields are found in many localities, notably at Princeton on what will probably become the line of the western extension of the Crows Nest Pass branch of the Canadian Pacific railway, at Nicola, near the main line of the Canadian Pacific railway, at Telkwa, near the line of the Grand Trunk Pacific railway, and at Tantalus, near the upper navigable waters of the Yukon.

The Vancouver Island coals are more or less normal bituminous, and some of them coke well. The others are largely, but not wholly lignite or lignitic-bituminous. Some coke well, but most of them are likely to prove unsuitable for metallurgical purposes (smelter coke); in general, however, they are excellent for domestic use and also for steam raising. Their impurities vary greatly, but on the whole these coals may be likened to those of the second division.

With such vast coal resources, of which but a comparatively small part is developed, it is, of course, impossible for any investigation to be made exhaustive, and in the present case no attempt has been made to deal seriously with any coals except those from mines already developed, and in condition to place their material on the market. Nearly all the mines in this condition have been sampled, and their product tested on a fairly large scale—usually 10 tons.

In the following list the coals tested are arranged geographically: beginning with the eastern part of the Atlantic coal field of Cape Breton, Nova Scotia.

LIST OF COALS TESTED.

50. Gowrie seam, North Atlantic Collieries, Ltd., Port Morien, N.S.
36. Dominion No. 7, Hub seam, Dominion Coal Co., Ltd., Glace Bay, N.S.
35. Dominion No. 9, Harbour seam, Dominion Coal Co., Ltd., Glace Bay, N.S.
35SP. Dominion No. 5, Phalen seam, Dominion Coal Co., Ltd., Glace Bay, N.S.
38. Dominion No. 1, Phalen seam, Dominion Coal Co., Ltd., Glace Bay, N.S.
37. Dominion No. 10, Emery seam, Dominion Coal Co., Ltd., Glace Bay, N.S.
39. Dominion No. 12, Lingan seam, Dominion Coal Co., Ltd., Glace Bay, N.S.
13. No. 1 colliery, Nova Scotia Steel and Coal Co., Ltd., Sydney Mines, N.S.
12. No. 3 colliery, Nova Scotia Steel and Coal Co., Ltd., Sydney Mines, N.S.
14. Inverness colliery, Inverness Railway and Coal Co., Inverness, N.S.
15. Port Hood colliery, Richmond Railway Coal Co., Ltd., Port Hood, N.S.
4. Six foot seam, Vale colliery, Acadia Coal Co., Ltd., New Glasgow, N.S.
16. Foord seam, Allan shaft colliery, Acadia Coal Co., Ltd., Stellarton, N.S.
1. Third seam, Albion colliery, Acadia Coal Co., Ltd., Stellarton, N.S.
2. Cage Pit seam, Albion colliery, Acadia Coal Co., Ltd., Stellarton, N.S.
8. Main seam, Acadia colliery, Acadia Coal Co., Ltd., Westville, N.S.
3. Main seam, Drummond colliery, Intercolonial Coal Mining Co., Ltd., Westville, N.S.
49. No. 1 colliery, Cumberland Railway and Coal Co., Ltd., Springhill, N.S.
5. No. 2 colliery, Cumberland Railway and Coal Co., Ltd., Springhill, N.S.
6. No. 3 colliery, Cumberland Railway and Coal Co., Ltd., Springhill, N.S.
7. Chignecto colliery, Maritime Coal, Railway and Power Co., Ltd., Chignecto, N.S.
9. Minudie colliery, Minudie Coal Co., Ltd., River Hebert, N.S.
10. Joggins colliery, Canada Coals and Railway Co., Joggins, N.S.
11. King's mine, G. H. King, Minto, N.B.
40. Western Dominion Collieries, Ltd., Taylorton, Sask.
41. Eureka Coal and Brick Co., Ltd., Estevan, Sask.
46. Strathcona Coal Co., Ltd., Strathcona, Alta.

42. Parkdale Coal Co., Ltd., Edmonton, Alta.
45. Standard Coal Co., Edmonton, Alta.
43. Canada-West Coal Co., Ltd., Taber, Alta.
44. Galt colliery, Alberta Railway and Irrigation Co., Ltd., Lethbridge, Alta.
47. Breckenridge and Lund Coal Co., Ltd., Lundbreck, Alta.
48. Seven foot seam (No. 1, Byron), Leitch colliery, Leith Collieries, Ltd., Passburg, Alta.
32. Hillcrest colliery, Hillcrest Coal and Coke Co., Ltd., Hillcrest, Alta.
33. No. 1 seam, Bellevue colliery, West Canadian Collieries Co., Ltd., Bellevue, Alta.
28. No. 1 seam, Lille colliery, West Canadian Collieries Co., Ltd., Lille, Alta.
34. No. 2 seam, Denison colliery, International Coal and Coke Co., Ltd., Coleman, Alta.
34SP. No. 4 seam, Denison colliery, International Coal and Coke Co., Ltd., Coleman, Alta.
31. No. 3 mine, Michel colliery, Crowsnest Pass Coal Co., Ltd., Michel, B.C.
30. No. 7 mine, " " " "
29. No. 8 mine, " " " "
51. No. 2 seam, South Hosmer Mines, Ltd., Hosmer, B.C.
52. No. 6 " " " "
53. No. 8 " " " "
53. No. 8 " " " "
27. No. 2 mine, Coal creek, Crowsnest Pass Coal Co., Ltd., Fernie, B.C.
26. No. 5 " " " " "
25. No. 1 or Old mine, H. W. McNeil Co., Ltd., Canmore, Alta.
23. Bankhead colliery, Bankhead Mines, Ltd., Bankhead, Alta.
24. Briquettes from Bankhead colliery, Bankhead Mines, Ltd., Bankhead, Alta.
Ex. 1, No. 1 opening, Granite Creek, B.C.
Ex. 2, No. 2 " " "
Ex. 3, No. 4 " " "
22. Jewel seam, No. 1 mine, Middlesboro colliery, Nicola Valley Coal and Coke Co., Ltd., Coutlee, B.C.
22SP. Rat Hole seam, No. 2 mine, Middlesboro colliery, Nicola Valley Coal and Coke Co., Ltd., Coutlee, B.C.
20. Wellington seam, Wellington-Extension colliery, Wellington Colliery Co., Ltd., Extension, B.C.
18. Upper seam, No. 1 mine, Western Fuel Co., Ltd., Nanaimo, B.C.
17. Lower seam, " " " "
21. Lower seam, No. 4 mine, Comox colliery, Wellington Colliery Co., Ltd., Cumberland, B.C.
21SP. Lower seam, No. 7 mine, Comox colliery, Wellington Colliery Co., Ltd., Cumberland, B.C.
Ex. 31. Upper seam, Tantalus mine, White Pass and Yukon Ry. Co., Ltd., Yukon.
Ex. 32. Middle seam, " " " "
Ex. 33. Lower seam, " " " "

A brief statement of the main features of each part of the work of testing will suffice for present purposes.

A. Sampling in the Field.—

The samples were taken by Theophile C. Denis, B.Sc., of the permanent staff of the Mines Branch, Department of Mines; or by Edgar Stanfield, M.Sc., chief chemist of the testing staff, one or other of whom visited and examined each mine to be sampled, and had the coal selected, sacked, sealed, and shipped under their own super-

vision. In taking this main sample every precaution was taken to secure average coal as sold; but in addition, smaller samples were personally secured and sent in sealed tins directly to the chemist.

In some cases, other samples were also taken to determine the difference between the several benches of coal as mined. Seams of minor importance were also sampled in lots ranging from a few pounds to one or more tons.

B. Crushing and Sampling in the Laboratory.—

The main sample on its arrival at the testing plant at McGill was unsacked; crushed to go through a 2″ screen; mixed thoroughly on a large granolithic sampling floor; sampled for the chemist, etc., and finally all re-sacked and set out for treatment.

C. Mechanical Purification—

Each main sample was experimentally treated in the laboratory with heavy solutions, and the fractions analysed with a view to determining the probable results of washing. In all cases where these preliminary tests gave favourable results, a large lot was treated in the coal washing plant of the University: the apparatus used being a standard two compartment slide motion jig, built for the Mines Branch by the Fraser & Chalmers Company. This jig has been specially remodelled for coal washing work, and is provided with automatic feed and side discharge devices for automatically removing the slate and other impurities. The purified coal overflows into a drainage box, in which it is collected and dried. The fine material passing down through the sieves is collected, and is either re-treated or wasted, depending upon its composition. Each of the tests was made on a lot of between 3 and 4 tons, which was first crushed, sized, and then jigged in three separate portions: coarse, intermediate, and small, in order to secure the most accurate work. The very fine coal was also treated when the coal was suitable for coking, or when, for any reason, there was likely to be a commercial justification for saving the fines. The products both of coal and waste were all recovered, weighed, and sampled; but the coarse and fine products were mixed before sending them to the boilers.

The coal washing work was checked by a series of tests with heavy solutions. It would, of course, be possible in a laboratory to do extremely thorough washing at an expense disproportionate to the value of the coal; but this was not attempted, the aim being to reproduce commercial conditions. From comparative tests made between laboratory work, and coal washing in standard plants, it is evident that this end has been attained, and the tests as carried on may be taken to represent average commercial work.

D. Boiler Trials.—

The boiler trials were conducted in the boiler testing room of the Mechanical Engineering Department of McGill University, and the method used was as far as possible in accordance with standard testing practice. The equipment employed in these tests includes a Babcock & Wilcox boiler: having 639 square feet of heating surface, and 16·79 square feet of grate area; an independent feed pump; weighing tanks, and standard scales for water and coal; together with the necessary apparatus for determining moisture in steam, analysing flue gases, and observing pressures and temperatures. Provision was made for supplying steam under the grate, and also for working under forced draft if required. Except in one or two cases where it was necessary to make a change, the same pattern of fixed grate bars was used throughout the tests. These bars have air spaces, the area of which is 30 per cent of the total grate area. If different grate bars had been used for different grades of fuel, better economy in some instances would probably have been obtained; but it was felt that by using the same grate throughout, the tests would be more completely comparable with one another.

Before commencing the tests, the boiler was thoroughly scaled, cleaned, and tested, and all brickwork around the furnace was rebuilt. Preliminary trials were then made with a standard coal (George Creek) to make certain that the whole equipment was in good order. The series of regular tests was then begun, the same fireman being employed throughout. It was not found possible to make more than one boiler trial with most of the samples of coal, and it was decided that in every case the same evaporation of 2,000 pounds of water per hour should be aimed at; this being a rate at which the boiler was known to give nearly its best efficiency. The results of the tests show, therefore, the rate at which each sample of coal had to be burnt in order to furnish a certain supply of steam. As a check, the heat losses in every case were determined as far as possible. All the tests were, at least, of ten hours' duration, and the boiler tubes were, of course, cleaned before each run.

Since the practical working of a coal in the fire has an important economic bearing on its industrial value as a fuel, continuous notes were made of such points as, the condition and thickness of the fire; the nature and amount of ash and clinker formed; the frequency of slicing and cleaning the fire; and the method of firing found most suitable for each particular fuel.

E. Producer Trials—

In the beginning, it was decided to attempt to carry out the boiler and gas producer tests on a somewhat small scale; owing to a wish to make the investigation of immediate value to the numerous small manufacturing and power plants which are springing up all through the country—especially in the west, where for many years they will play a leading part in its industrial development. It was also desired to test all coals with equal thoroughness, and as nearly as possible under identical conditions; and the transportation of even ten ton samples for distances ranging from 800 to 3,000 miles was a sufficiently serious matter. Hence it was decided to work on a scale of approximately 40 horse-power, although it was known that bituminous coal gas producers had not been altogether perfected for so small an output. But assurances were given by several of the leading firms making producers that they could provide the necessary apparatus.

When, however, specifications were prepared and tenders asked for, the makers both at home and abroad exhibited an unexpected reluctance to guarantee their machinery, and much time was lost in correspondence. In the meanwhile, an anthracite producer of approved form was installed, and a series of trial runs on anthracite, coke, etc., were commenced in order to drill the staff, and get the apparatus in working order. Ultimately the makers of two well-known types of producers undertook to build plants for bituminous coal, and did actually erect producers with the necesssary tar extraction apparatus; but in both cases the producers failed to meet the requirements originally specified, and consequently were removed.

The experience gained in the tests above mentioned enabled Professor Durley to design a down draught producer which fulfilled the requirements, and after the long series of preliminary tests necessary to arrive at a trustworthy method of operation, it was possible to begin the final tests on the series of coal samples.

As in the boiler trials, the method of flying start was used; the actual runs lasting 24 hours, and the total operation almost 36. This time was as long as could be managed without a very large increase in the staff, and an even greater increase in the cost; but these 24 hour tests were checked by a sufficient number of longer trials —one lasting 10 days— to show that the apparatus was quite capable of doing commercial work.

Criticism may be made against the use of one producer for all classes of coal— from semi-anthracite to lignite; but in any series of tests it is undesirable to change the apparatus or the conditions of work more than is absolutely necessary. The results, in this case, have justified the course taken. It is scarcely necessary to say that

the scrubbers, washers, tar extractors, etc., were so fitted that they could be cut out by means of valves and by-passes, and that they were not used except when necessary.

F. Coking Trials—

The question, will a certain coal make good coke, is one of great practical importance and until now it has been difficult to answer it without first conducting a series of oven trials on a large and costly scale. Even a full-sized experimental oven is unsuitable for such work, as its operation differs much from that of an oven surrounded by others. The only safe course has been to send a very considerable quantity of each coal, to be tested, to a bank of ovens, and to test it under standard conditions; repeating the operation if necessary with different coking periods until a definite conclusion can be reached.

It was obviously impossible to carry out costly tests of the above character on all of the fifty odd coals in the series under consideration; therefore, an extended investigation was undertaken at the works of the Dominion Iron and Steel Company, Sydney, N.S., with a view to developing some reliable method of working on a small scale. These experiments, supplemented by tests on various types of ovens in different places in Canada, finally led to a satisfactory conclusion: and it is now possible to test coals in lots of, say, 50 pounds, the resultant cokes being in every way similar to those produced in commercial ovens, and in most cases indistinguishable from them.

The method, in brief, is as follows:—

The sample of coal, which should be as fresh as possible, is crushed, washed, if necessary, and slightly moistened in some cases, and is thus brought to exactly the condition in which it would normally go to the ovens. It is then put into rectangular boxes of heavy sheet iron—each holding, say, 50 pounds. These boxes are freely perforated to permit of the escape of gas; but the perforations are blanked with paper to prevent the egress or ingress of coal. The boxes are weighed and placed in an oven which is being charged, and, in fact, become a part of its regular charge, and are coked under perfectly normal conditions. On the withdrawal of the charge the boxes are quenched as promptly, yet as lightly as possible, and are then dried and weighed before being opened.

In addition to the straightforward trials to determine whether the several coals would or would not coke, a series of tests was made to determine the effect of moistening, compressing, etc., also different temperatures, and duration of the coking period.

A method had to be devised, also, to determine the strength of the cokes produced. Mere crushing tests do not suffice, and it was finally decided to adopt a standard method of testing in a tumbler, to determine the losses in handling, and of crushing to a fixed pressure in bulk, to determine strength in coke bins and furnaces.

In addition to the above experiments on the production of metallurgical coke, a limited number of coals have been retorted, and the gases and tar have been studied qualitatively and quantitatively. This work is, however, somewhat beyond the strict limits of the investigation, and it has been impossible to carry it as far as might be desired.

Another series of tests has been made to determine the effect of weathering and of washing on coke production. Some coals will only coke when quite fresh; others will coke—but not so well—when stale; while others do not seem to be affected even by comparatively long exposure to the air. The whole matter is somewhat obscure, and chemical analysis does not cast as much light on it as one could wish.

G. Chemical Laboratory—

The work that had necessarily to be done in the Chemical Laboratory has been very considerable. Methods and apparatus have had to be devised, tested and standardized, and all materials, whether raw, temporary, or final products, have had to be

analysed. No count of the total number of analyses has ever been made, but each complete test of a coal has involved over 400 separate determinations. The following enumeration of the different materials analysed, and of the different analyses, determinations, and investigations carried out, will give some idea of the extent of the work done.

Materials analysed.—Coal samples: main, mine, weathering, boiler trial, gas producer tests, coking tests, final washed coal, separate products of washery, specific gravity tests, screen analyses, etc. Coke samples from coking tests; gas samples from boiler trials, gas producer tests, and coking tests; ash samples from boiler trials, gas producer tests, and laboratory combustion of raw and washed coal.

Chemical Determinations made.—Carbon, hydrogen, oxygen, sulphur, nitrogen, moisture, ash, volatile matter, fixed carbon, combustible matter, carbon dioxide, carbon monoxide, ethylene, methane.

Physical Determinations made.—Fusion temperature of ashes; specific gravity, porosity and strength of cokes; calorific values of solid and gaseous fuels.

Special Investigations have been made on the determination of sulphur in coal; determination of volatile matter in coal and coke; solubility of coal in water; determination of physical values of coke; weathering of coal, etc. An investigation is also carried out on the spontaneous combustion of coal in storage, but as this is in addition to the original research and is being supported by private contribution, it is not intended to incorporate the results in the main report.

CHEMICAL LABORATORIES.

(*a*) Sussex St.
(*b*) Wellington St.

F. G. Wait, M.A., F.C.S.

The work done in the chemical laboratories during 1909 has been of the same varied character as in former years, and in the twelve months ended December 31, 875 specimens have been examined and reported upon.

During recent years there has been a gradual increase in the number of specimens received from persons other than the regular field staff of the Department. To such an extent have these specimens increased that the time of our present staff was almost fully occupied in attending to this commercial work. Not only was the legitimate function of the laboratory interfered with; but as no charge was made for such work, it was felt that we were entering into unfair competition with chemists in private practice outside. To overcome this latter condition of affairs, and in order to divert as much of this purely commercial work as possible into other channels, a schedule of charges was drawn up, and, after approval by the Honourable the Minister of Mines, became effective on June 29, 1909.

There has been only a slight diminution in the number of such specimens received, and, as prepayment of charges is demanded, it is scarcely possible to postpone the required examinations. In consequence, as matters stand to-day, we are not able to keep abreast of the work coming to us from our own staff. As a matter of fact, in order that reports might not be unduly delayed, I have been obliged to recommend that some of our chemical work be done by outside chemists. This is a state of affairs which should not exist; but if the chemical work of the Department is to be done—as it assuredly ought to be—within our own walls, it is imperative that our present staff be augumented, and our accommodation be increased, and re-arranged accordingly.

A detailed report of the work done during 1906, 1907, and 1908 has been prepared, and is now in the press.

In carrying out the work during the year, Mr. M. F. Connor, B.Ap.Sc., and Mr. H. A Leverin, Ch. E., have rendered faithful and efficient service.

The work done during the year may, for convenience, be arranged as follows:—

I. Fuels, comprising:—

1. *Peat*—2 samples from—
   (a) New Brunswick—An undefined locality.
   (b) British Columbia—Lulu island.

2. *Lignite*—36 samples from—
   (*a*) Saskatchewan.
      i. South shore of Bear (Pipe) lake—in unsurveyed territory.
   (*b*) Alberta.
      i. Leitch's collieries, at Passburg—5 samples.
      ii. United collieries—Ritchie mine—Edmonton.
      iii. N.W. Gas and Oil Co.'s property—Jaspar Ave., Edmonton.
      From drill hole No. 2, at a depth of 1,440 feet.
      iv. Rakowski's mine—sec. 18, tp. 48, R. 19, W. of 4th.

v. Bower's mine, Canmore—sec. 28, tp. 24, R. 20, W. of 4th.
vi. Threehills mine—sec. 22, tp. 24, R. 31, W. of 4th.
vii. Shaft mine, Threehills—sec. 20, tp. 31, R. 24, W. of 4th.
viii. Ben Nevis 'coal'—sec. 12, tp. 38, R. 22, W. of 4th—2 samples.
ix. Curwin and Kelly's mine—sec. 8, tp. 55, R. 25, W. of 4th.
x. " " —Sturgeon valley, S.E. ¼, sec. 8, tp. 55, R. 25, W. of 4th.
xi. Cardiff mine—N.W. ¼, sec. 24, tp. 55, R. 24, W. of 4th—2 samples.
xii. Alberta Coal Co.'s property, Morinville, Alta.—N.E. ¼, sec. 23, tp. 55, R. 24, W. of 4th; lower part of seam.
xiii. Gillmuth's mine—sec. 34, tp. 38, R. 23, W. of 4th.
xiv. Ketchum's mine—N.W. ½, sec. 7, near Clover Bar, Edmonton.
xv. Clover Bar Coal Co.'s property—N.W. ¼, sec. 7, tp. 23, R. 53, W. of 4th.
xvi. Parkdale Coal Co.'s property—on river lots 22 and 24, Edmonton.
xvii. Standard mine—on river lot 26, Edmonton.
xviii. White Star mine—sec. 25, tp. 51, R. 25, W. of 4th—3 samples.
xix. Strathcona mine—on river lot 7, Strathcona.
xx. Twin City Coal Co., Strathcona—on river lot 19, Strathcona.
xxi. From a large boulder of coal, measuring 30 x 30 x 10 feet, lying on the S.E. corner of Strathcona townsite—on sec. 22, tp. 24, R. 52, W. of 4th.
xxii. Bow Centre mine—secs. 8 and 9, tp. 17, R. —, W. of 4th.
xxiii. Potters' mine, south of Bawlf—sec. 15, tp. 44, R. 19, W. of 4th.
xxiv. Near Round Hill, north of Bawlf.
xxv. From a depth of 100 feet, in the town of Bawlf.
xxvi. Red Willow creek—property of Glen Hays Coal Mining and Development Co., in tp. 40, R. 18, W. of 4th.
xxvii. Star collieries, near Taber—sec. 8, tp. 10, R. 17, W. of 4th.

3. *Lignitic Coals*—7 samples from—
(*a*) Alberta—
i. Lethbridge coal—sec. 25, tp. 9, R. 22, W. of 4th—2 samples.
ii. Russell claim, head of McLeod river—sec. —, tp. 46, R. 23, W. of 4th.
iii. S.W. ¼, sec. 19, tp. 42, R. 26, W. of 4th.
iv. Pacific Pass Coal Co., Little Pembina river—sec. 12, tp. 47, R. 19, W. of 5th—from the upper 6 feet of the seam.
v. Grassy lake, east of Taber.
vi. Athabaska river, two miles below Oldman river.

4. *Coal*—23 samples from
(*a*) Nova Scotia—
i. Vicinity of West Arichat, Richmond county.
(*b*) New Brunswick—
ii. Gloucester county—from a boring 500 feet deep, made by a calyx drill, in Tilley road, Tracadie.
iii. Gloucester county—an undefined locality.
(*c*) Quebec—
i. From a 3 ft. seam in Devonian strata on the beach at Cape Haldimand, Gaspé county.
(*d*) Alberta—
i. From Well No. 2 of the Calgary Natural Gas Co.—2 samples: the first from a depth of 2,582 to 2,587 feet, and the second from 2,656 to 2,664 feet.
ii. North branch of the Brazeau, opposite Prairie camp—on sec. 18, tp. 45, R. 20, W. of 5th; a 3 ft. seam.

iii. Rose creek—sec. 6, tp. 43, R. 19, W. of 5th; seam, 5'-8".
iv. Smith creek, a branch of the South Brazeau—sec. 24, tp. 41, R. 19, W. of 5th.
v. Russell claim, head of McLeod river—sec.—, tp. 46, R. 23, W. of 5th.
vi. North Branch of the Brazeau—sec. 1, tp. 45, R. 21, W. of 5th—2 samples.
vii. Fiddle creek, a branch of the Athabaska river, near Jasper House, twelve miles south of the G.T.P.
viii. Sec. 9, tp. 44, R. 21, W. of 5th.

(*e*) British Columbia—
i. Vicinity of Hazelton, Skeena mining division—2 samples.
ii. Morice river, Omineca mining division—2 samples.
iii. Vicinity of Babine lake, Skeena mining division.
iv. Granite creek, Similkameen mining division—5 samples.

5. *Anthracitic coal*—8 samples from—
(*a*) British Columbia—
i. Property of the Western Development Co., Skeena River division—6 samples.
ii. Discovery creek, Skeena River division.
(*b*) Yukon—
i. A point two miles west of Union mines, Wheaton River district.

6. *Anthraxolite*—3 samples.

Examination of three samples of what proved to be anthraxolite, from the parish of St. David, three-quarters of a mile west of the town of Lévis, was made upon material selected with the utmost care by Dr. A. W. G. Wilson.

II. Iron Ores—76 samples, comprising:—
1. *Magnetite,* from—
(*a*) Quebec—
i. Pontiac county, Bristol mine—5 samples.
(*b*) Ontario—
i. Timagami district—17 samples.
ii. Frontenac county, South Canonto township—1 sample.
iii. Hastings county, Mayo township—9 samples.
iv. Lanark county, Darling township—6 samples.
v. Renfrew county, Blithfield township—1 sample.
(*c*) Alberta—
i. From the Livingston range—sec. —, tp. 8, R. 3. W. of 5th—2 samples.

2. *Hematite*—from—
(*a*) Nova Scotia—
i. Hants county—1 sample.
ii. Pictou county—15 samples.
(*b*) Ontario—
i. Lanark county, Darling township—6 samples.

3. *Limonite*—from—
(*a*) Nova Scotia—
i. Pictou county, vicinity of Bridgeville—11 samples.
ii. Queens—1 sample.

4. *Ilmenite*—from—
(*a*) Quebec—lots 19 and 20, of South Ham, Wolfe county.

III. Copper Ores—25 samples from:—

(*a*) Prince Edward Island—

i. Governor island, near Charlottetown—copper content, 51·96 per cent.

(*b*) Quebec—

i. Bonaventure county—lot 9, R. V. of Matapedia—copper content, 2·61.

ii. Brome county—lot 28, R. IX of Potton—copper, 0·53 per cent.

iii. Sherbrooke county, Ascot township—2 samples from the Suffield mine.

iv. Wolfe county—lot 22, R. II of Weedon—2 samples.

(*c*) Ontario—

i. Abitibi district—lot 12, con. III, of Clergue; a slightly cupriferous nickeliferous pyrrhotite.

ii. Lanark county, Lavant township—lot and con. not stated.

iii. Nipissing district—Montreal river—3 samples.

(*d*) Alberta—

i. Vicinity of Banff—copper content 4·16 per cent.

(*e*) British Columbia—

i. Kaslo—1 sample containing 31·55 per cent of copper.

ii. Phœnix—1 sample from the Snowshoe mine, copper 12·68 per cent.
1 sample from the Brooklyn mine, copper 10·29 per cent.
1 sample from the War Eagle mine, copper 6·10 per cent.
1 sample from the Granby mine, copper 2·00 per cent.

iii. Queen Charlotte islands—5 samples, ranging from 0·43 to 19·11 per cent of copper.

(*e*) Yukon—

i. Merritt creek—2 samples from the Homestake property.

ii. Williams creek—2 samples, one from the Monte Cristo claim and one from the Bonanza King.

IV. Ores of Nickel and Cobalt—7 samples from:—

(*a*) New Brunswick—

i. Charlotte county, parish of St. Stephen—nickel, 1·90 per cent.

(*b*) Quebec—

i. Pontiac county—lot 10, R. XI, of Clarendon.

(*c*) Abitibi district—lot 12, con. III, of Clergue—nickel, 5·15 per cent.

(*d*) Nipissing district—4 samples from Montreal river; none contained above 0·47 per cent of nickel.

V. Manganese:—

Four samples of manganiferous limonite—kidney ore—from the vicinity of Bridgeville, Pictou county, Nova Scotia, were found to contain manganese ranging in amount from 31·80 per cent to 0·46 per cent.

VI. Limestones and Dolomites—28 samples from—

(*a*) Nova Scotia—

i. Cape Breton county—2 samples.

ii. Halifax county—1 sample.

iii. Inverness county—1 sample.

iv. Lunenburg county—5 samples.

v. Pictou county—12 samples.

(*b*) Quebec—

i. Shefford county—2 samples.

ii. Wolfe county—5 samples.

VII. Brick and Pottery Clays—16 samples from:—

(*a*) Nova Scotia—
i. Cape Breton county—1 sample.
ii. Cumberland county—1 sample.
iii. Halifax county—2 samples.

(*b*) Quebec—
i. St. John county—1 sample, tested with a view to its utilization in cement manufacture.

(*c*) Saskatchewan—
i. Near Bienfait—on sec. 12, tp. 2, R. 6, W. of 2nd—8 samples.

(*d*) Alberta—
i. Leitch's collieries, near Passburg.

(*e*) British Columbia—
i. Vicinity of Enderby—1 sample.
ii. Vicinity of Ladysmith—1 sample.

VIII. Gypsum—86 samples from—

(*a*) Nova Scotia—
i. Cape Breton county—6 samples.
ii. Colchester county—32 samples.
iii. Inverness county—22 samples.
iv. Richmond county—6 samples.
v. Victoria county—19 samples.

IX. Rock and Mineral Analyses—40 specimens:—

The analyses of rock specimens referred to in my last summary report as being in course of completion have been concluded and reported upon. In all, 38 samples of rocks, and of so-called 'alum rock'—all from British Columbia—and 1 chromiferous and titaniferous magnetite from South Ham, have been done.

X. Oil Shales—42 samples:—

These are all from Albert county, New Brunswick, and have been analysed with a view to ascertaining their value when submitted to destructive distillation by determining the quantity of oil and ammonium sulphate which each produces.

XI. Natural Waters—5 samples from:—

(*a*) Nova Scotia—
i. Richmond county—from a boring 470 feet deep, at Cleveland.
ii. Lunenburg county—from a spring in the vicinity of Riverport.

(*b*) New Brunswick—
i. York county—from a spring one mile and a quarter southwest of Astley crossing, in Stanley parish.

(*c*) Quebec—
i. Kamouraska county—from a spring at St. Germain—Cadastral lot 36, range I.

(*d*) Ontario—
i. Prescott county—from a spring on lot 14, con. VII of Alfred.

XII. Natural Gas—1 sample from Calgary Natural Gas Co.'s well.

XIII. Magnetic Sands.

An examination has been made of 12 metallic (copper) reguli, or buttons, which were prepared by fusion of pure copper with the concentrated and washed portions of stated weights of black magnetic iron sands from different portions of the Dominion. The sands were worked in this way to ascertain their content of heavy metals—gold, platinum, osmiridium—and the copper was added merely as a collector of the heavier metals during fusion.

These sands so treated were from:—

(*a*) Ontario—

i. Shore of Lake Erie.
ii. Granite island, Georgian bay.
iii. Sudbury—2 samples.

(*b*) British Columbia—

i. Queen Charlotte islands—2 samples.

(*c*) Yukon—

i. Near Dawson.

(*d*) Five additional samples were examined, but the locality of their origin was not stated.

XIV. Gold and Silver Assays.

As in the past, the specimens submitted for assay have come from every province of the Dominion, and have represented all kinds of material. During the year just past 250 specimens have been assayed.

These were as follows:—

(*a*) Nova Scotia—6 samples.
(*b*) New Brunswick—2 samples.
(*c*) Quebec—26 samples.
(*d*) Ontario—92 samples.
(*e*) Manitoba—1 sample.
(*f*) District of Keewatin—1 sample.
(*g*) Saskatchewan—5 samples.
(*h*) Alberta—2 samples.
(*i*) British Columbia—37 samples.
(j) Yukon Territory—6 samples.

In addition to the foregoing, some 72 samples were submitted to assay, but no particulars of locality being furnished, they are not included in the above classification.

XV. Miscellaneous Examinations.

Under this heading are grouped some 200 specimens, or more, which were sent in by mail, or brought by the persons most interested. In many cases a mere description of the material sufficed, in others a partial analysis was required, but in every case report was made, either orally or by letter.

REPORT OF THE DIVISION OF MINERAL RESOURCES AND STATISTICS.

J. McLeish, Chief of the Division.

In submitting a report on the work of this Division during the calendar year 1909, it is gratifying to be able to say that, although the year was begun with a considerable amount of arrears of work on hand—consisting in the delayed preparation of the final report on the mineral production of Canada during 1907—it closes with the work much more up to date than has been the case for a number of years past.

The main causes which contributed to the delay in the preparation of our annual reports, namely, the greatly increased volume of work on the one hand and a reduction in the staff on the other, have been met, in part (1) by the appointment of one assistant during the year; (2) provision for the appointment of a second; and (3) completion of the reports referred to: which was made possible through the assistance rendered by other members of the Mines Branch staff.

As soon as convenient after the first of January, letters, and circular requests were sent out to the mining community throughout Canada from whom returns of production were desired; and towards the latter part of February sufficient information had been received and compiled upon which to base a preliminary report on the mineral production of Canada during the calendar year 1908.

The manuscript for this report was sent to the printers on February 25, and the printed report (16 pages) was received on March 2. Copies were distributed at the annual convention of the Canadian Mining Institute held at Montreal, March 3, 4, 5, 1909. A paper on the mineral production during the year was also read at the convention, thus placing before the mining community and the public, at the earliest opportunity, information concerning the extent of our mineral output.

In connexion with the early publication of this preliminary report, acknowledgments are due as usual to the various Provincial Mining bureaus for their hearty co-operation in furnishing estimates, and particularly to the Provincial Mineralogist of British Columbia for a detailed preliminary estimate of the mineral production in that Province; also to several of the railway corporations for furnishing statements of the shipments of ores from stations on their lines. Although the figures of output are subject to some variation in the final report—necessarily published much later in the year—the statistics and general résumé showing mining progress furnish a fairly approximate estimate of the mineral production during the year.

The annual report on the mineral production during the calendar year 1906, was not received for distribution until May 18. The revised annual report for 1907 having been completed, it was decided to combine the reports for 1907 and 1908 in one issue: and to publish as separate pamphlets important sections as soon as each was completed. In pursuance of this plan the following reports have been prepared, and sent to press on the dates indicated:—

The Production of Cement in Canada during the calendar year 1908—May 14, 1909.

The Production of Asbestos in Canada during the calendar years 1907 and 1908—August 24, 1909

The Production of Chromite in Canada during the calendar years 1907 and 1908—August 24, 1909.

The Production of Iron and Steel in Canada during the calendar years 1907 and 1908—August 24, 1909.

The production of Coal, Coke, and Peat in Canada during the calendar years 1907 and 1908—August 24, 1909.

The Production of Natural Gas and Petroleum in Canada during the calendar years 1907 and 1908—September 10, 1909.

These were issued as advance chapters of the complete Report on the Mineral Production of Canada during the Calendar Years 1907 and 1908, and were all received and distributed before the close of the year. The complete report was transmitted on December 13. It includes, for the first time, a special chapter on smelter production: returns having been received, through the courtesy of the owners, from all the operating smelters in Canada. A summary of the mineral production in each province has been added into the introduction or general review. Many new tables have been introduced, and old ones condensed and revised. The statistical information respecting structural materials and clay products is also much more complete than formerly, although there is still much room for improvement in this respect.

The publication of statistics of smelter production draws attention once more to a subject that has been fruitful of much discussion, viz., the desirability of securing greater uniformity—as between the various Provincial mining bureaus and the Federal Department of Mines—in the collection, compilation, and publication of mining statistics.

Hitherto, attention has been directed more particularly to the different bases adopted for valuing metallic mineral products. The Bureau of Mines of British Columbia uses a value based on the final value of the refined metal, making no allowance for freight and treatment charges; while the Ontario Bureau of Mines uses such value for the material produced—whether ore or matte—as is placed thereon by the operator; such values representing in general the value of the point of production. The Bureau of Mines of Nova Scotia does not attempt to place any value upon its mineral production, being content with publishing quantities only.

In compiling statistics of metal production from ores—a large portion of which are shipped out of the country for smelting or refining—it is perhaps quite as essential that the estimation of quantities should be on a uniform basis as it is that the valuation should be uniform.

It has become the practice on this continent to describe metal production in terms of fine metal, whether the metal is actually recovered in a refined condition or not. In Canada, quite a considerable tonnage of our ores is exported to be both smelted and refined in other countries; the greater part of our ore tonnage is, however, smelted in local furnaces, the products of which—consisting chiefly of 'blister copper' and 'matte'—are exported for further treatment and refining.

The smelting and refining processes are invariably accompanied by a partial loss of the metals which it is aimed to recover. This loss will vary with different ores and different smelting methods, and may, in special cases, approach as high as 25 to 30 per cent of the original metal contained in the ore.

It will be apparent, therefore, that there will be a very important distinction between statistics of metal production based on exact assays of ores and statistics based on the quantities of metals actually contained in the products 'blister' and 'matte,' etc., produced by the smelters.

The collection of smelter statistics by this Branch for the year 1908—the results of which have been published in the annual report of this Division for that year—has drawn marked attention to this distinction.

As an illustration of the differences here referred to, we may cite the fact that the production of nickel from the Sudbury ores of Ontario is represented both by the Ontario Bureau of Mines and by this Branch as the quantity of nickel contained in

matte which is shipped to the United States and Great Britain for refining. This quantity will be less (from 7 per cent to 10 per cent) than the quantity of nickel contained in the ore sent to the smelter. The same remarks apply to the copper contents of these ores.

On the other hand, in the case of the silver production of the Cobalt District ores, the production is expressed as so many ounces of fine silver contained in the ore shipped, no allowance being made for the smelter losses. In fact, as the larger portion of these ores is treated in the United States smelters and in conjunction with ores from other sources, it would probably be difficult, if not impossible, to obtain records of the quantity of silver metal actually recovered.

The practice of the Bureau of Mines of British Columbia is to collect statistics based on the assay values of each shipment. The figures given, therefore, represent the 'total gross contents (of shipments) without smelter deductions.' In dealing with such low grade copper ores as those of the Boundary district of this Province (copper contents averaging about 1½ per cent or less), and ores so low in copper as those of Rossland, the difference between statistics of production based on assays and those based on copper recovered by the smelters, will be greatly accentuated. In fact, in cases such as these, the difference as regards copper may approximate as much as 25 per cent or more of the original copper contents of the ore.

The copper production of British Columbia in 1908, according to the statistics published by the Bureau of Mines, representing 'The total gross contents of shipments without smelter deductions,' was 47,274,614 pounds; while smelter returns received by the Mines Branch showed that the quantity of copper contained in the matte and blister produced by the smelters of British Columbia (including the Northport smelter in the State of Washington) was 37,041,115 pounds. A small tonnage of ores was shipped from the coast mines to United States smelters, the results of which are, of course, not included in the latter figure. This amount, however, includes the results of the treatment of a small tonnage of United States ores which were treated in the Canadian furnaces. This difference may at first sight appear somewhat startling, but the explanation is apparent when it is remembered that the smelting of the Boundary low grade ores involves a loss of from 25 to 30 per cent of the original copper contained in the ore.

Such conditions do not afford a fair means of comparing the metal production of one province with that of another, nor of comparing the metal production of Canada with that of other countries, where the statistics published represent the quantities of metals recovered.

The collection of statistics of smelter production will be continued by this Division, and an endeavour made to estimate the smelter results of those ores shipped out of the country for treatment, either through actual smelter returns of recoveries or by means of the percentage of metal contents paid for by the customs smelters.

Ores sent to customs smelters are usually paid for on a schedule basis: payment being made for a fixed or variable percentage of the metals contained in the ore, and penalties applied for excess of undesirable constituents. Such schedules, in general, contain many conditions, and vary not only with time, but with each class of ore to which they are applied, as well as with the special requirements of the customs smelter issuing them. Frequently, they will be the result of special negotiations between buyer and seller.

On the basis of such sales of ore, however, it should be possible to obtain statistics showing the quantities of metals—for which payment was made by the purchasing smelter—contained in each shipment.

In reviewing the subject it would appear that the collection of statistics of metal production may properly be viewed from at least four distinct standpoints:—

(1.) Statistics showing the total quantities of metals contained in the ores shipped, as determined by assay, without respect to whether these metals are finally recovered either in whole or in part, or not.

(2.) Statistics showing, in the case of ores sold to custom smelters, the quantities of metals for which payment was made by such purchaser, and, in the case of ores mined and smelted by the same operator, the quantities of metals contained in the smelter products obtained.

(3.) Statistics showing the quantities of metals contained in unrefined products, such as matte, blister, bullion, etc., of the various smelters.

(4.) Statistics showing the actual metal products of refining plants.

Statistics compiled from the first viewpoint, while having an important academic interest, hardly satisfy the requirements of the metal merchant.

Statistics compiled from the fourth viewpoint have probably the most important practical value, but, unfortunately for Canada, represent a fraction only of our metal production.

Statistics from the third viewpoint, showing smelter production, would not completely represent the total metal production of Canada.

Experience in the United States has shown that statistics of mine production, as explained in the second viewpoint, agree fairly closely with statistics of smelter production from the third viewpoint. The former affords a means of crediting production to particular localities, while the latter gives probably a more exact record of metal production.

In Canada, owing to the local smelter production not including all ores shipped, a combination of these two methods of viewing metal statistics would probably give the most satisfactory results.

Besides the considerable correspondence necessitated in connexion with the collection of statistics of mineral production, a good deal of time is occupied in the correspondence and preparation of information for inquirers respecting the mineral industries, and mineral resources of the Dominion.

The card catalogue of mineral occurrences requires a review of all official mining reports, as well as the transactions of mining societies: such as the Canadian Mining Institute, and many others, in order that it may be kept up to date.

It is intended, also, in the immediate future, to proceed with a card catalogue of all mining operators throughout Canada; this being considered much the most convenient method of keeping such lists.

In connexion with the preparation of reports published during the year, due acknowledgment is made of the assistance given by Mr. Howells Frèchette, M.Sc., in the preparation of the Preliminary Report on the Mineral Production of Canada during 1908, published in March, and of the assistance rendered by Mr. Theo. C. Denis, M.E., who prepared the special reports on coal, coke, and peat, petroleum and natural gas, together with other chapters included in the final annual report on mineral production. Mr. John M. Casey—formerly professor of mathematics in Ottawa College—was appointed as assistant to the Division, in June, 1909, and will take special charge of the statistical compilations.

With the appointment of an additional technical officer, provided for, it is hoped that it will be possible to publish our statistical reports much earlier than has been possible under past conditions.

A Preliminary Report on the Mineral Production of Canada during the calendar year 1909, with revised statistics for 1908, has been printed as a separate publication (No. 62), and is reproduced as an appendix.

REPORT COVERING THE OPERATIONS OF THE DOMINION OF CANADA ASSAY OFFICE, VANCOUVER, B.C., DURING THE YEAR ENDED DECEMBER 31, 1909.

There were 573 deposits of gold bullion, requiring 613 melts and 613 assays (quadruplicate check assays being made in each instance), including the assembling and remelting of the individual deposits, after purchase, into bars weighing about 1,200 troy ounces each, and the assaying of same. The aggregate weight of the deposits before melting was 48,478·60 troy ounces and after melting 47,576·27 troy ounces, showing a loss in melting of 1·8613 per cent. The loss in weight by assaying was 5·63 troy ounces (base and parted silver), the average fineness of the resulting bullion, viz., 47,570·64 troy ounces, being 0·802 gold and 0·178 silver. The net value of the gold and silver contained in deposits was $789,267.94.

A substantial increase is reported of the gold output of the Yukon for the year 1909 as compared with the previous year; very little of same, however, was marketed at this office, there being a decrease of 57,142·79 troy ounces received from the Yukon during the year 1909 as compared with the former year. The greater part of the Yukon gold output is now shipped to San Francisco by registered mail, the transportation charges being the same from Dawson,Y.T., to San Francisco, as from Dawson to Vancouver, B.C. The charges imposed at the different institutions in San Francisco for the purchase of gold bullion are one-eigth of one per cent less on the gross value of the bullion than at this office. If a rebate were allowed of one-eighth of one per cent on the gross value of all bullion from the Yukon deposited at this office on which the Royalty or export tax had been paid, it would be the means of diverting the Yukon gold output to Vancouver; and incidently keep the prestige (a valuable asset, especially if the operations of the Assay Office were of such volume as to warrant weekly or even monthly publication), and trade accompanying the marketing of the gold in this country.

The gold bullion received came from the following sources, viz.:—

Source.	Deposits.	Weight.		Net value.
		Before melting.	After melting.	
	No.	Ozs.	Ozs.	$ cts.
Yukon Territory	81	5,130·36	5,003·12	83,870 84
British Columbia	458	36,708·91	35,970·03	602,530 75
Alberta	6	60·99	41·74	766 77
Alaska	27	6,552·33	6,535·49	101,605 49
California	1	26·01	25·89	494 09
	573	48,478·60	47,576·27	789,267 94

Weight before melting	48,478·60	ounces.
Weight after melting	47,576·27	"
Loss by melting	902·33	"

Loss percentage by melting =1·8613.

Credits and Disbursements for the Purchase of Gold Bullion and receipts from sale of same during the Year ended December 31, 1909.

—	$ cts.	$ cts.
Disbursements for purchase of bullion on hand January 1, 1909, bars Nos. 1295, 1296, 1298, 1299, and 1301 to 1342 inclusive		47,731 86
Disbursements for purchase of bullion during year ended December 31, 1909—Cheques Nos. 1343 to 1412 inclusive and Nos. 1 to 548 inclusive—omitting the following Nos. issued in payment for nuggets (Gold Nugget Collection), viz., Nos. 68, 73, 83, 92, 96, 103, 109 to 113 inclusive, 120, 124 to 126 inclusive, 159, 169, 170, 204, 207 to 213 inclusive, 218, 219, 222, 233, 237, 238, 258, 263 to 265 inclusive, 286, 287, 291, 295, 304, 351, and 361 to 363 inclusive		789,267 94
Proceeds from sale of bullion during year ended December 31, 1909	826,502 08	
Value of bullion on hand December 31, 1909, bars Nos. 524, 530, and 536 to 548 inclusive	11,169 64	
Difference in favour of this Office		671 92
	837,671 72	837,671 72
Unexpended balance, "Letter of Credit", January 1, 1909		21,084 28
Credits established during year ended December 31, 1909		900,000 00
"Letter of Credit" balance written off at close of fiscal year, March 31	16,839 59	
Disbursements for purchase of bullion	789,267 94	
Disbursements for purchase of nuggets (Gold Nugget Collection)	4,584 71	
Unexpended balance, "Letter of Credit", December 31, 1909	110,392 04	
	921,084 28	921,084 28

Contingent Account for Year ended December 31, 1909.

—	$ cts.	$ cts.
Unexpended balance, January 1, 1909		140 68
Funds provided per official cheques Nos. 826, 882, 935, 3, 55, 184, 239, 310, 362, 431, 498, and 573		5,250 00
Amount remitted Receiver General, per Draft No. 114, at close of fiscal year, March 31, 1909	119 47	
Expenditure during year ended December 31, 1909	5,115 70	
Unexpended balance, December 31, 1909	155 51	
	5,390 68	5,390 68

Contingent Expenditure for Year ended December 31, 1909.

Rent	$2,775 00
Fuel, gas	265 45
Fuel, coal	39 00
Light and power	161 25
Express charges on bullion	672 06
Express charges on stationery from Ottawa	6 50
Installation of electric vault protection	375 00
Electric vault protection service	300 00
Postage and telegrams	20 39
Telephones	67 50
Customs duty, freight, etc., on assayers' and melters' supplies	22 40
Assayers' and melters' supplies, (purchased locally)	156 39
Insurance, transportation, and telegrams in connexion with Gold Nugget Collection	119 00
Sundries	135 76
	$5,115 70

SESSIONAL PAPER No. 26a

Proceeds from Residues sold March, 1909.

Slag sold to Joseph Mayer & Bros.	$183 75
Silver sold to Joseph Mayer & Bros.	45 63
Cornets and residues sold to Assay Office, Seattle	490 00
40 empty acid bottles sold to British Columbia Assay and Chemical Supply Co., Ltd.	6 00
9¾ lbs. mercury sold to British Columbia Assay and Chemical Supply Co., Ltd	3 70
For melting and rolling into strips, 21 ounces foreign silver coins	5 00
	$734 08

Residues on Hand December 31, 1909.

Slag from melting of bullion	265 lbs.
Granules	13·24 ounces.
Silver	9·08 "
Empty Winchesters	34 only.

The following shows the business done by the Assay Office since its establishment:—

Year.	Number of Deposits.	Weight, (Troy ozs.)	Net value.
			$ cts.
1901-2, fiscal	671	69,925·67	1,153,014 50
1902-3 "	509	36,295·69	568,888 19
1903-4 "	381	24,516·36	385,152 00
1904-5 "	443	29,573·73	462,939 75
1905-6 "	345	21,050·83	337,820 59
1906-7, nine months	269	20,695·84	336,675 65
1907-8, fiscal	482	46,540·25	751,693 97
1908, nine months	590	90,175·48	1,478,893 74
1909, calendar	573	48,478·60	789,267 94

CHANGES IN STAFF.

Mr. Ross H. Fillion, computer and bookkeeper, resigned May 31, 1909. Mr. G. N. Ford was appointed computer and bookkeeper on June 1, 1909, at a salary of $100 per month, to succeed Mr. R. H. Fillion.

IMPROVEMENT OF EQUIPMENT.

An electric burglar alarm for protection of the vault door was installed during the month of December, 1908, and connected with the office of the British Columbia District Telegraph and Delivery Company. Electric protection for the walls, roof, and floor of the vault was installed later, viz., during the month of March, 1909, the equipment being so constructed that it can be transferred and applied to another vault of similar size.

ASSAY OFFICE QUARTERS.

The lease of the Assay Office quarters expired November 30, 1909, and an extension to April 30, 1910, was arranged at an increase of rent from $225 to $300 per month.

Arrangements have been practically completed to prepare part of the ground floor and basement of the old post-office building for the Assay Office.

GOLD NUGGET COLLECTION.

Instructions were received on June 10, 1909, to make a collection of gold nuggets, value not exceeding sum of $10,000, and forward same, properly insured, to R. L. Broadbent, C/o Canadian Exhibition Commission, Alaska-Yukon-Pacific Exposition, Seattle, Wash., U.S.A., disbursements for purchase of the nuggets to be made from 'Letter of Credit.'

One hundred nuggets weighing 259·35 ounces, containing 244·90 ounces bullion and 14·45 ounces matrix, were collected and forwarded as directed, the total sum paid for same being $4,584.71, an average of $17.68 per ounce or $18.72 per ounce for the bullion which they contained, the weight of bullion being determined by specific gravity.

In addition to the above expenditure from 'Letter of Credit,' the sum of $119 was paid from the 'Contingent Account' for insurance, transportation, and telegrams, making a total of $4,703.71.

Mr. William Hutchison, Canadian Exhibition Commissioner, wrote from Seattle on October 13, 1909, stating that he had been requested by Hon. Sydney A. Fisher, B.A., Minister of Agriculture, to secure these nuggets for exhibition purposes and that he (Mr. Hutchison) would, therefore, take over the nuggets and be responsible for them until arrangements were made with the Department of Mines.

The following is a summary showing the source, weights, etc., of the nuggets, viz:—

Mining District.	Number of nuggets.	Weight of Matrix.	Weight of Bullion.	Gross Weight.	Amount paid.
		Ozs.	Ozs.	Ozs.	$ cts.
Atlin, B.C.	40	6·35	142·99	149·34	2,573 82
Cariboo, B.C.	53	6·10	82·53	88·63	1,645 87
Fort Steele, B.C.	3	0·91	8·09	9·00	161 80
Skeena, B.C.	3	0·38	5·30	5·68	95 40
Yukon Territory	1	0·71	5·99	6·70	107 82
	100	14·45	244·90	259·35	4,584 71

G. MIDDLETON,
Manager.

December 31, 1909.

G. MIDDLETON, Esq.,
Manager,
Dominion of Canada Assay Office,
Vancouver, B.C.

SIR,—The following is the list of the assayers' supplies on hand, viz.:—

Silver nitrate crystals	1 oz.
Calcic chloride	⅔ lb.
Copper wire	½ spool.
Lead foil, C.P.	100 lbs.
Cupels	about 5,000
Nitric acid	10 Winchesters.

Hydrochloric acid	1 Winchester.
Sulphuric acid	¾ "
Ammonia	1 "
Zinc (Mossy) C.P.	½ lb.
Lead (Granulated)	6 lbs.
Scorifiers, 4"	9
" 2¼"	55
Spare muffles	16
" doors	6
" supports	4
" back stops	4
" plugs	17
Litharge	25 lbs.
Bone ash ..... about	20 "
Gold cornets	8·16 ozs.
Gold proof	5·92 "
Silver	60·19 "
Silver proof	0·49 ozs.
Fireclay ..... about	25 lbs.

Yours obediently,

J. B. FARQUHAR,
Chief Assayer.

December 31, 1909.

G. MIDDLETON, Esq.,
Manager,
Dominion of Canada Assay Office,
Vancouver, B.C.

SIR,—I beg to inform you that we have on hand in the Melting Department the following supplies, viz.:—

3	sets of linings with supports and covers complete,			for	No. 1 furnace.
3	"	"	"	"	No. 2 "
3	"	"	"	"	No. 4½ "
4	"	"	"	"	No. 7 "

4	Graphite crucibles,	No. 10
60	" "	No. 16.
20	" "	No. 30.
28	" "	No. 40.
55	" "	marked ⁰/₀

2 Crucible covers, No. 50.
2 " " No. 16.
2 Graphite stirrers.
2 Wire brushes.
4 lbs. Pot. Nitrate.
35 lbs. Carb. Soda.
70 lbs. Borax Glass.

Your obedient servant,

D. ROBINSON,
Chief Melter.

ACCOUNTANT'S STATEMENT.

The following is a statement of difference in value of assays between Seattle Assay Office and Dominion of Canada Assay Office from April 1, 1908, to March 31, 1909.

Paid for bullion at Dominion of Canada Assay Office, Vancouver	$	1,583,166 57
Received for bars from United States Assay Office, Seattle		1,584,058 94
Difference in favour of Dominion of Canada Assay Office		892 37

STATEMENT OF DEPOSITS OF GOLD AND EARNINGS.

Deposits of Gold		1,583,166 57
Earnings—		
Value of 89 ozs. silver sold Jos. Mayer & Bros	$ 45 63	
" cornets and residue sold United States Assay Office	490 00	
" sweeps sold Jos. Mayer & Bros	183 75	
" 40 acid bottles and 9 lbs. mercury sold B.C. Assay & Chemical Supply Co	9 70	
For melting 21 ozs. silver coins	5 00	
	$ 734 08	
Difference between amount paid and received for bullion	892 37	
	$ 1,626 45	

The following is a statement of appropriation, receipts, and expenditure for the year ended March 31, 1909, and shows the unexpended balance to be $11,788.55:—

—	Appropriation.	Expenditure.
	$ cts.	$ cts.
Appropriation, 1908-9	26,000 00	
Receipts per the foregoing statement	734 08	
Difference between amount paid and received for bullion	892 37	
Rent		2,550 00
Fuel		340 86
Power and light		172 93
Postage and telegrams		108 70
Telephone		66 00
Express charges		1,288 60
Assayers supplies		291 81
Printing and stationery		49 01
Premium and Fidelity bonds		590 16
Electric burglar alarm service		625 00
Contingencies		118 83
Wages—		
G. Middleton		2,500 00
J. B. Farquhar		1,800 00
D. Robinson		1,700 00
A. Kaye		1,500 00
G. B. Palmer		900 00
R. Fillion		660 48
P. W. Thomas		233 87
E. Tierney		341 65
Balance unexpended		11,788 55
	27,626 45	27,626 45

Unexpended balance, March 31, 1909, lapsed, $11,788.55.

(Signed) JOHN MARSHALL,
Accountant, Department of Mines.

FIELD WORK

PRELIMINARY REPORTS.

ON THE MOLYBDENUM ORES OF CANADA

T. L. Walker, M.A., Ph.D.

In accordance with instructions I spent a little over two months examining some of the chief deposits of molybdenite in the Maritime Provinces and Quebec.

In recent years there has been a relatively good market for ores of molybdenum owing to the properties imparted to steel by the introduction of a small proportion of molybdenum. The resulting steel is much in demand for tool steel owing to its retaining its temper when heated to a high degree. Similar properties are obtained by the use of tungsten, but to obtain the same result about twice as much tungsten is necessary.

The ore supply has been very irregular, and at times not sufficient to meet the demand. The price has risen, until now molybdenite 92 per cent pure MoS_2, free from copper arsenic and bismuth, is valued at from $550 to $600 per ton.

The chief ores are molybdenite—MoS_2—and wulfenite—$PhMoO_4$. Only the former is known to occur in promising deposits in Canada. Molybdenite is usually found in or near granite or gneissoid rocks. Since eastern Canada contains very extensive areas of these rocks it seems reasonable to expect that these regions should supply at least a part of the molybdenum required for metallurgical purposes. Up to the present nothing beyond initial prospecting has been attempted. It is hoped that a systematic examination of the leading granite areas and molybdenite deposits may contribute towards the development of a molybdenum industry in Canada.

In Nova Scotia I visited nearly all the known deposits—near Jordan falls, Shelburne county; New Ross, Lunenburg county; Glengarry and Gabarus, in Cape Breton. These properties have not been developed.

In New Brunswick molybdenite is known to occur, but no attempt has so far been made to develop the deposits.

In Quebec where the areas of granite and gneiss are very extensive, a great many occurrences of molybdenite have been recorded, but none of the properties have been fully explored. I examined some of the deposits at Romaine and Peaster bays, on the north shore of the Gulf of St. Lawrence, and also some of those to the north of the Ottawa river in Alleyn, Egan, Aldridge, and Calumet townships. The only place where explorations were being carried on was at Romaine, where Lt.-Col. John Carson, of Montreal, and associates had a party of about ten men employed.

While working in New Brunswick near the Maine border I paid a visit to the adjacent molybdenum fields in the State of Maine. There the molybdenite is scattered widely through a granite rock, which seems to be available in considerable quantity, so that the ore could be quarried. At Cooper, Me., some years ago considerable ore was quarried and treated by crushing and dry concentration in a mill specially designed for the purpose. For many years no work had been done, though there were reports of proposed re-opening of the quarry and mill.

At Catharine Hill, Me., ore of a similar type is available, but nothing has been done beyond a little prospecting and preliminary development.

Few of the Canadian deposits examined appear to be of the type presented at Cooper and Catharine Hill. It is hoped that the information gathered at Cooper and Catharine Hill may be of value in the preparation of a report on Canadian molybdenum deposits.

Four chief types of deposit have been observed in my examination of the molybdenite deposits of Quebec and the Maritime Provinces. The ore mineral occurs:—

(1.) In white veins of quartz;
(2.) In very coarse granite pegmatite;
(3.) In green pyroxene rock;
(4.) Associated with copper ores.

I am at present engaged in an examination of the material collected, with a view to preparing a bulletin on molybdenum ores in Canada.

THE MAGNETIC CONCENTRATION OF IRON AND COPPER NICKEL ORES.

Geo. C. Mackenzie, B.Sc.

I beg to submit herewith a preliminary report upon the work now in progress, dealing with the magnetic concentration of two iron ores, one each from the Provinces of Quebec and New Brunswick; also the separation of an Ontario copper nickel ore.

After consultation with you regarding the iron areas to be experimented upon, my instructions were to confine the work for the winter of 1909-1910 to the concentration of the high sulphur ores of the Bristol mines, situated on lots 21 and 22, range II, township of Bristol, county of Pontiac, in the Province of Quebec, and to the leaner and more siliceous material found associated with the merchantable ore of the Bathurst mines of the Canada Iron Corporation, Limited, situated on lot 12, range XVII, township of Bathurst, county of Gloucester, in the Province of New Brunswick.

With your approval I completed arrangements with the authorities of the School of Mining at Kingston, Ontario, for the temporary rental of their mining laboratory: which contains the necessary crushing, grinding, classifying, and magnetic separating machinery required for experimental work of this character. Concentration tests will be carried out in this laboratory until such time as the ore dressing plant for the Mines Branch, now building in Ottawa, is ready for occupation.

On September 22, 1909, I left Ottawa for the Bristol mines, and upon arrival found Mr. Einar Lindeman, of the Mines Branch, engaged in making a magnetometer survey of the deposits. Mr. Lindeman very kindly accompanied me over the property, giving me the benefit of his field experience, and I was much impressed with the result of his work, indicating, as it did, the presence of large bodies of magnetic iron ore. After an examination of the property it was apparent that much difficulty would be experienced in the selection of a sample representative of the run of mine ore. All of the old pits and open workings being filled with water prevented any attempt being made to secure a large sample of the ore *in situ*. Upon examination of the dumps it was discovered that such ore as they contained was badly weathered. However, it was found that by removing the surface ore and taking that portion underneath which had been protected somewhat from the weather, a sample could be obtained that would approximately represent the condition of the ore as originally mined. In selecting the samples larger pieces of rock were cobbed out, but no attempt was made to select pieces of ore free from sulphur, as it was intended to show that subsequent magnetic separation would eliminate the sulphur to a large extent.

Shipment No. 1 was taken from the mine dump near the engine house at No. 1 incline shaft.[1]

Shipment No. 2 was taken from a small dump on the Killroy farm, situated 550 feet southeast of No. 1 shaft. The ore on the dump was mined some years ago from an open pit marked No. 2[2] on Mr. Lindeman's map of the property, which accompanies this report. This dump was found to be more badly weathered than that from which the first shipment was taken, and considerable picking over and sorting was necessary before a sample could be obtained that was at all representative.

Both samples were bagged and shipped to the mining laboratory of the School of Mining at Kingston, Ont.

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1 *See* Mr. Lindeman's map of the Bristol Mines, accompanying this report.
2 Ibid.

On October 6 I left Ottawa for the Bathurst mines of the Canada Iron Corporation, Limited. On my way through Montreal I called upon Mr. John T. Drummond, manager of mines and furnaces for the Corporation, who received me courteously and gave me a letter of introduction to the mine superintendent at Austin brook. The mines are reached by taking the Intercolonial railway to Bathurst station, and from thence driving a distance of twenty-six miles to the junction of Austin brook with the Nipisiguit river.

Mr. T. T. Fulton, the mines superintendent, to whom thanks are due for his kind hospitality during my visit, accompanied me over the two deposits of ore so far being exploited. At the time of my visit mining operations were confined to the most northerly part of No. 1 deposit, which outcrops on the south side of Austin brook, in the form of a steep bluff about 80 feet high. The width of the ore body at this point is approximately 100 feet. Mining consists of open-cut bench work on the face of the bluff, the broken ore being conveyed to the end of a trestle and dumped on the ground level with a railway siding now building. From this dump it will be loaded on cars and shipped to a junction on the Intercolonial railway via a branch line of railway now under construction.

The ore on the face of this bluff, more particularly on the western side, is distinctly of merchantable grade, being free from much interbanded silica; hand specimens exhibit no sign of sulphides. On top of the bluff and about 100 feet back from the face, the ore contains more interbanded silica, with a little iron pyrites. This interbanded material does not, however, extend across the width of the deposit, the banded material being more in evidence on the east side, diminishing gradually towards the western limit. It is evident that much of this banded material must be cobbed out, if shipments are to be made containing in the neighbourhood of 55 per cent of iron, and as the rejected portion will in time amount to a considerable tonnage and contain between 30 and 40 per cent of iron, it is a matter of some importance to investigate the possibility of recovering this iron by means of magnetic separation.

A sample of this banded material was, therefore, taken from No. I deposit, care being taken to select only that portion which would of necessity be rejected in the process of hand cobbing. This sample was marked Shipment No. 1.

Deposit No. II, situated on the north side of Austin brook, is not as large as No. I, having a width of approximately 30 feet. The bands of siliceous material are, however, not so wide or so numerous in this deposit. The sample taken from this outcrop was selected with the same care as that taken from No. I deposit, but for reasons just stated, it is probably higher in iron than the other.

Both samples were sacked and shipped to the School of Mining at Kingston, Ont.

CONCENTRATION TESTS WITH BRISTOL ORE.

Shipment No. 1.—This shipment consisted of a fairly coarse-grained magnetite in a gangue hornblende, feldspar, calcite, and free quartz. Iron pyrites is present in considerable quantity, not finely disseminated, but occurring in stringers and nodular masses throughout the ore.

Analysis of this shipment so far completed is as follows:—

General sample A—

Iron	53·500	per cent.
Insoluble residue	17·460	"
Sulphur	3·620	"
Phosphorus	0·011	"

The net weight of this shipment was 3,758 pounds. The ore was broken to ¾ inch in a Blake crusher, thence fed to Cornish rolls, crushing to ⅛ inch, the discharge from the rolls passing over a 6 mesh impact screen; oversize being returned to the

rolls, until all of the ore had been reduced to the required size. The crushed ore was then piled on a sampling floor, and a sample selected for analysis by the split shovel method. This sample was marked 'General Sample A,' and represented the shipment as received.

Approximately one-half of the shipment was taken for wet separation, the remaining half to be concentrated by the ordinary dry method, the two portions weighing 1,922 and 1,836 pounds respectively.

That half of the shipment reserved for wet separation was then split into three equal portions; the first portion being ground into a Krupp ball mill to a fineness of 10 mesh, the second ground to a fineness of 20 mesh, and the third to a fineness of 40 mesh. Each of these three portions was then separated independently by the Grön-dal magnetic separator. The results obtained afford comparisons of the efficiency of separation with the different sizes of the same material.

The following figures illustrate the results obtained after wet separation, with the different sizes of Bristol No. 1 Shipment:—

Size of Feed.	Weight of Feed.	Concentrates.		Tailings.		Loss.	
		Weight.	Per Cent.	Weight.	Per Cent.	Weight.	Per Cent.
	Pounds.	Pounds.		Pounds.		Pounds.	
Through 40 mesh....	648	504	77·77	132	20·37	12	1·86
" 20 "	535	424	79·25	101	18·87	10	1·88
" 10 "	639	532	82·25	100	15·64	7	1·11

Analyses of the above concentrates and tailings have not been completed, hence full data cannot be given. After the above separation the tailings in each case were found to contain a large proportion of sulphides, indicating that the original sulphur contents of the crude had been reduced considerably in the concentrates.

That portion of the shipment reserved for dry separation, weighing 1,836 pounds, was then sized over impact screens; the object of this sizing process being to assemble particles of the same size irrespective of specific gravity, the practical effect of which is to increase the efficiency of the subsequent separation process. The screens selected for this sizing process were as follows: 40 mesh, yielding particles finer than 40 mesh; 20 mesh, yielding particles larger than 40 mesh, and finer than 20; 10 mesh, yielding particles larger than 20 mesh and finer than 10, and 6 mesh, yielding the final product consisting of particles larger than 10 mesh and finer than 6 mesh. Each of the sized products was then piled on the sampling floor and a sample taken for analysis by the split shovel method, these samples being marked Nos. 1, 2, 3, 4, for 40, 20, 10, and 6 mesh sizes respectively. A summation of the analysis of these four different sizes should approximate with the analysis of the General Sample A, affording a check upon the whole.

The sizing process by the impact screens gave the following figures:—

Size of Material.	Weight in Pounds.	Per Cent.
Through 40 mesh.....	714	38·85
" 20 and on 40 mesh.....	355	19·35
" 10 " 20 "	378	20·60
" 6 " 10 "	389	21·20

Neither analysis nor results of dry separation of the above material can be given at this date, this portion of the work not having been finished.

Shipment No. 2.—This ore differs radically from No. 1 in that it contains considerable hematite. The crystallization is finer, and iron pyrites, which occurs as fine stringers and splashes throughout the ore, is more evenly distributed. The gangue of this ore contains more calcite than the gangue of No. 1, and the percentage of insoluble matter is considerably lower.

Analysis of this ore so far completed is as follows:—

General Sample A—

Iron	51·830
Insoluble residues	9·970
Sulphur	2·790
Phosphorus	0·008

The net weight of this shipment was 4,323 pounds.

The ore after being broken to $\frac{3}{4}$ inch in the Blake crusher, received exactly the same treatment as that given Shipment No. 1. The General Sample A, which was selected after crushing to $\frac{1}{6}$ inch, and marked 'Bristol Mines, No. 2,' represents the shipment as received.

The ore was then divided into two portions for wet and dry separation, the portion for wet separation weighing 1,904 pounds. The following figures illustrate the results obtained after wet separation, with the three different sizes of No. 2 ore:—

Size of Feed.	Weight of Feed.	Concentrates.		Tailings.		Loss.	
		Weight.	Per Cent.	Weight.	Per Cent.	Weight.	Per Cent.
	Pounds.	Pounds.		Pounds.		Pounds.	
Through 40 mesh....	664	472	71·08	172	25·90	20	3·02
" 20 "	622	392	63·02	199	31·99	31	4·99
" 10 "	618	346	55·98	229	37·05	43	6·97

Comparing the above figures with results obtained from separation of No. 1 ore, it is apparent that the percentage of concentrates is much lower for No. 2 ore. This is explained by the fact that No. 2 ore in the crude contained a considerable quantity of hematite, which being non-magnetic entered the tailings. This hematite has no doubt originated largely from oxidation of the iron pyrites contained in the ore, the dump from which this shipment was taken having been exposed to weathering agencies for many years. No difficulty was experienced with the elimination of sulphides, these minerals being found to enter the tailings readily.

The portion of No. 2 Shipment reserved for dry separation—weighing 2,319 pounds—was then sized for dry separation, on the impact screens. The following figures give the percentages and weights of the four different sizes, after preliminary crushing to $\frac{1}{8}$ inch.

Size of Material.	Weight in Pounds.	Per Cent.
Through 40 mesh.....	866	37·40
" 20 and on 40 mesh.	303	13·08
" 10 " 20 "	525	22·64
" 6 " 10 "	625	26·88

Samples of the above sized material were selected by the split shovel. Neither analyses nor results of dry separation have as yet been completed.

CONCENTRATION TESTS WITH THE BATHURST ORE.

Shipment No. 1.—This ore (if such it may be called) consists of cryptocrystalline magnetite and hematite interbanded with extremely fine-grained siliceous material consisting almost entirely of quartz. The bands of siliceous material alternating with the bands of magnetite vary from ½ to 1 inch in thickness, and impart to the ore a laminated structure. Iron pyrites occurs with this banded ore to some extent, but is present only in small amount. Analyses of this shipment have not yet been completed.

The net weight of this shipment was 3,411 pounds. The crude ore being broken to ¾ inch in the Blake crusher, was then crushed to ⅛ inch in Cornish rolls, oversize being returned until all had passed the 6 inch mesh screen. The ore was then sampled with the split shovel, and this sample marked Bathurst General Sample A. The shipment was then divided into two portions for wet and dry separation, weighing respectively 1,484 and 1,927 pounds. The portion for wet separation was then subdivided into approximately three equal parts; the first part being ground in the Krupp ball mill to a fineness of 60 mesh, the second to a fineness of 40 mesh, and the third to a fineness of 20 mesh. Separation tests with these three sizes have not yet been completed, hence no figures can be given.

The remaining portion of the shipment for dry separation was then sized by passing the ore over the impact screens. The following figures give the weights and percentages of the different sizes, after preliminary crushing to ⅛ inch.

Size of Material.	Weight in Pounds.	Per Cent.
Through 40 mesh	447	23·19
Through 20 and on 40 mesh	124	6·43
Through 10 and on 20 mesh	416	21·59
Through 6 and on 10 mesh	940	48·78

Neither analyses nor separation of the dry material have been accomplished as yet.

Shipment No. 2.—This ore is similar in appearance to No. 1, possessing the same cryptocrystalline banded structure. The siliceous bands are, however, less numerous, therefore this shipment will, it is expected, be higher in iron than No. 1.

No analyses of this ore have been completed. This shipment, weighing 3,557 pounds, received exactly the same treatment as that given to No. 1. The ore, after a preliminary breaking to ¾ inch in the Blake crusher, was crushed to ⅛ inch in Cornish rolls, and then sampled.

After selection of the general sample A, the ore was then divided into two portions for wet and dry separation, weighing respectively 1,433 and 2,124 pounds. The portion for wet separation was then split into three parts, the first part being ground to 60 mesh, the second to 40 mesh, and the third to 20 mesh, each portion to be separated independently. Wet separation of this material has not yet been accomplished.

The portion for dry concentration, after the sizing treatment by the impact screens, gave the following figures:—

Size of Material.	Weight in Pounds.	Per Cent.
Through 40 mesh	437	20·57
Through 20 and on 40 mesh	178	8·38
Through 10 and on 20 mesh	637	29·99
Through 6 and on 10 mesh	872	41·05

Neither anayses nor separation of the dry material have been accomplished as yet.

MAGNETIC SEPARATION OF A COPPER NICKEL ORE.

On November 2, I received a letter from you instructing me that you were sending one ton of copper nickel ore in the lump, and on November 8, you advised me of a second shipment of copper nickel ore, consisting of fines.

The first shipment (lump ore) was received on November 18, 1909. The second shipment, consisting of fines, has not yet been received.

Your letter of instructions regarding this ore was that I should experiment for the production of magnetic heads, free from copper, the separation process at the same time yielding a tailings product, free from nickel.

The shipment of lump ore, as received, weighed 1,268 pounds, and consisted of copper pyrites and pyrrhotite in a gangue of dark coloured eruptive rock. The ore was first broken in the Blake crusher to $\frac{3}{4}$ inch, and then reduced to $\frac{1}{4}$ inch size by Cornish rolls, the oversize being returned from a $\frac{1}{4}$ inch impact screen. The crushed ore was then piled on the sampling floor and thoroughly mixed by repeated conning, after which it was sampled by means of the split shovel.

Analysis of this sample for copper and nickel gave the following result:—

	Per cent.
Copper	3·49
Nickel	4·56

The crushed ore was then subdivided into three parts, the first portion being ground in the Krupp ball mill to a fineness of 60 mesh, the second to a fineness of 40, and the third to a fineness of 20 mesh. Each portion was then treated independently by the magnetic separator, the idea of so treating the three portions being to gain information as regards the behaviour of the copper and nickel minerals when concentrated at different sizes.

Wet magnetic separation after the Gröndal system was employed throughout this work, the exciting current being fixed at 5 amperes.

Three products were obtained from each separation of this ore; (1) magnetic heads which were caught in a spitzkasten settling box; (2) slimes from the heads, these being in a fine state of subdivision, floated off from the spitzkasten and were caught in a second settling box of larger area; (3) tailings which were caught in a second pair of settling boxes. After the ore had passed through the separator, each of the above tanks was allowed to settle, the water drained off, and the several products collected, dried, and weighed.

Concentration of the 60 mesh material yielded the following results, after the first pass of the original crude:—

	Copper, per cent.	Nickel, per cent.
Heads	1·96	4·02
Tails	5·23	5·58

It is apparent from the above analysis that a considerable portion of the nickel-bearing minerals are either feebly or non-magnetic. Hence, the tails were re-passed through the separator twice, in an effort to lower their nickel contents; and in order that feebly magnetic minerals should be attracted, the exciting coils were changed from series to parallel, increasing the current from 5 to 20 amperes. The result of this re-concentration of the first tailings is illustrated by the following analyses:—

	Copper, per cent.	Nickel, per cent.
Heads	5·16	5·59
Tails	6·79	5·28

The above results exhibit conclusive proof that a clean separation of the nickle-bearing minerals from the copper pyrites cannot be accomplished by the Gröndal wet method of concentration. It would no doubt be possible to lower the nickel contents of the tailings by passing them over a high tension machine such as the Wetherill magnetic separator; but as the Wetherill machine operates on dry material only, the heads product from such a separation process would contain considerable copper, because small particles of copper pyrites would undoubtedly enter the heads through the agency of mechanical entanglement.

Complete results of concentration of the 60 mesh material are given in the following table; the magnetic portion from the first operation being called heads, the magnetic portion from the re-concentration of the tailings being termed seconds, and the non-magnetic portion from this re-concentration being termed tails.

CONCENTRATION OF 60 MESH: COPPER NICKEL ORE.

Crude Ore.			Heads.				Slime.				Seconds.				Tails.				Loss.	
Weight.	Analysis.		Weight.	Per cent.	Analysis.		Weight.	Per cent.	Analysis.		Weight.	Per cent.	Analysis.		Weight.	Per cent.	Analysis.		Weight.	Per cent.
Lbs.	% Cu.	% Ni.	Lbs.		% Cu.	% Ni.	Lbs.		% Cu.	% Ni.	Lbs.		% Cu.	% Ni.	Lbs.		% Cu.	% Ni.	Lbs.	
393	3·49	4·56	215·5	54·83	1·96	4·02	16·5	4·19	4·49	3·69	86	21·89	5·16	5·59	49	12·47	6·79	5·28	16	4·07

Note.—Ten pounds of the tailings from the first concentration were taken for sample; this amount equals 2·54 per cent of the weight of original crude.

CONCENTRATION OF THE 40 MESH SIZE.

After the first pass of this material through the separator analysis of the heads and tails gave the following results:—

	Copper, per cent.	Nickel, per cent.
Heads	1·80	4·22
Tails	6·09	5·39

The tailings from the above operation were then reconcentrated, with the machine in parallel, being passed twice, with the following results:—

	Copper, per cent.	Nickel, per cent.
Heads	5·08	5·68
Tails	7·44	5·68

The above results tally approximately with the figures obtained after separation of the 60 mesh material, furnishing additional proof that a large proportion of the nickel-bearing minerals are feebly magnetic. Complete results of concentration of this 40 mesh material are tabulated below, the first magnetic portion taken out being termed heads, the second magnetic portion being termed seconds, and the final non-magnetic residue being called tails.

CONCENTRATION OF 40 MESH : COPPER NICKEL ORE.

Crude Ore.			Heads.				Slime.				Seconds.				Tails.				Loss.	
Weight.	Analysis.		Weight.	Per cent.	Analysis.		Weight.	Per cent.	Analysis.		Weight.	Per cent.	Analysis.		Weight.	Per cent.	Analysis.		Weight.	Per cent.
Lbs.	% Cu	% Ni	Lbs.		% Cu.	% Ni.	Lbs.		% Cu.	% Ni.	Lbs.		% Cu.	% Ni.	Lbs.		% Cu.	% Ni.	Lbs.	
348	3·49	4·56	206·5	59·34	1·80	4·22	12·5	3·59	4·37	3·96	59	16·95	5·08	5·68	53	15·23	7·44	4·94	10·0	2·87

NOTE.—Seven pounds of the tailings from the first concentration were taken for sample; this portion equals 2·01 per cent of the weight of original crude.

CONCENTRATION OF THE 20 MESH SIZE.

The concentration of the 60 and 40 mesh sizes previously described having shown the impracticability of recovering in the magnetic heads more than approximately 50 per cent of the original nickel content, it was decided that the older phase of the problem, *i.e.*, the production of magnetic heads free from copper, should receive its due share of attention.

A glance at the analyses of the heads products from concentration of the 60 and 40 mesh sizes, will show that they contain over 30 per cent of the copper contained in the original crude. This fact deserves some explanation. Copper pyrites when pulverized to a fine state of subdivision has a marked tendency to slime, and when water is used as a carrying medium for this slime, the mineral in fine, scaly particles will float on the surface, due to a surface tension of the liquid. Now in the Gröndal system of magnetic separation the various mineral particles are brought into a magnetic field by a stream of water flowing over a dam or bridge wall, situated immediately below the electro-magnets; the mineral particles being held freely in suspension by the water, the magnetic portion is drawn out towards the magnetic field, the non-magnetic portion escaping as tailings. It will be understood then that in this particular problem the fine copper slimes floating on the surface of the water will adhere to the particles of pyrrhotite as they are lifted through the surface of the water towards the magnetic field.

From the foregoing remarks it would appear that a solution of this problem would be realized if in the preparation of the ore for concentration, precautions were taken to avoid an excess of slime, viz., by the use of crushing machinery yielding a more granular product; or by the elimination of slimes from the pulp before concentration is attempted, using hydraulic classifiers. This particular phase of the problem will be dealt with at greater length in a more exhaustive report.

In concentration of the 20 mesh material an attempt was made to lower the copper contents of the heads product by adjustment of the separator. The only alteration seemingly consistent with the foregoing remarks, appeared to be a reduction of the exciting current, which would result in a lower percentage of magnetic heads recovered, but with a corresponding reduction of their copper content. The exciting current was therefore reduced from 5 to 3 amperes, and after the first pass of this 20 mesh material, analyses of the heads and tails gave the following results:—

	Copper, per cent.	Nickel, per cent.
Heads	0·53	3·62
Tails	5·25	3·58

The tailings from the above were then re-concentrated with the machine in parallel, using 20 amperes. Analyses of the resulting heads and tails gave the following figures:—

	Copper, per cent.	Nickel, per cent.
Heads	5·01	5·45
Tails	6·90	4·49

Complete results of the concentration of the 20 mesh material are tabulated below, the first magnetic portion being termed heads, the second magnetic portion being termed seconds, and the final non-magnetic portion being termed tails.

CONCENTRATION OF 20 MESH : COPPER NICKEL ORE.

Crude Ore.			Heads.				Slime.				Seconds.				Tails.				Loss.	
Weight.	Analysis.		Weight.	Per cent.	Analysis.		Weight.	Per cent.	Analysis.		Weight.	Per cent.	Analysis.		Weight.	Per cent.	Analysis.		Weight.	Per cent.
Lbs.	% Cu.	% Ni.	Lbs.		% Cu.	% Ni.	Lbs.		% Cu.	% Ni.	Lbs.		% Cu.	% Ni.	Lbs.		% Cu.	% Ni.	Lbs.	
368·5	3·49	4·56	145·5	39·48	0 53	3·68	10·5	2·85	4·15	3·62	131	35·55	5·01	5·45	56	15·17	6·90	4·49	9	2·44

Note.—Sixteen and a half pounds of the tailings from the first concentration were taken for sample; this amount equals 4·48 per cent of the weight of original crude.

Further experimental work looking to the production of magnetic heads free from copper will be undertaken and the results published in a later report. This work will probably consist of a re-treatment of the different sizes of magnetic heads in hydraulic classifiers, and subsequent magnetic separation of the classified material.

The analysis, I made from samples dried at 105°C. for one hour.

INVESTIGATION OF SOME MANGANESE ORE DEPOSITS IN NOVA SCOTIA AND NEW BRUNSWICK.

Theo. C. Denis, M.E.

The manganese industry of Canada has been dormant for nearly twenty years, although previous to that time it was comparatively active. A short investigation as to the reasons for this cessation of work was made during the fall of 1909, and the following notes are the result of a visit to the principal manganese-bearing districts in the Provinces of Nova Scotia and New Brunswick.

The ores of manganese extracted from deposits in the Maritime Provinces, during the period of activity of the mines, were mainly pyrolusite, manganite, and psilomelane, all of exceptional purity, and high grade; although a deposit of wad or bog manganese was also worked for a short time. The ores were shipped mainly to Boston and New York, where they were used in the manufacture of chemical products; in the manufacture of glass, in the production of oxygen, etc. Very high prices were obtained for these ores: some shipments from Tennycape, Nova Scotia, having realized as much as $125 a ton, and a small quantity having even been sold at $140 a ton. None of these high grade ores were sold at less than $45 to $50; but some of lower grade were shipped to steel works as blast furnace ore. The preparation at the mines was mainly done by hand cobbing.

During the last season the following deposits were visited: in Hants county, Nova Scotia, the Tennycape mines, the Parker mine, and the Walton deposits; in Kings county, New Brunswick, the Jordan Mountain mine, the Markhamville deposits; and in Albert county of the same Province, the Shepody Mountain mine, and the Dawson Settlement deposits.

Tennycape Mines.—These workings are situated one mile and a quarter, in a straight line, to the southeast of Tennycape post-office, or slightly over two miles by the road. Schooners can be loaded at the mouth of Tennycape river near the post-office. The nearest railway station is at present Kennetcook—some 13 miles distant—on the Dominion Atlantic Railway branch, between Truro and Windsor.

The manganese deposits, according to Mr. Hugh Fletcher's geological map of the district, are found at the junction of the Devonian shales and sandstones, and the overlying Carboniferous limestones and dolomites. The ore, however, is mostly found in the limestone, which is highly magnesian, and the shales and sandstones form the floor of the workings. The general strike of the manganese formation is 20° south of east (astronomically) and the average dip about 30° south. The ore was found in the dolomitic rock, in very irregular masses, varying in size from small nodules of a few inches, to pockets, the largest of which is said to have yielded about one thousand tons of good ore. From these nodules and pockets, veins and fissures radiate—more or less filled with manganese ore—which, in places, present a net work crossing the rock in all directions.

The workings consist of a long open-cut, 500 feet in length, 40 to 60 feet wide; and one main shaft, sunk at a spot 125 feet to the south of the edge of the main cut, and reaching the floor of the manganiferous rocks at a depth of 160 feet. From the bottom of the open-cut a shallow shaft was sunk, and a long tunnel of some 200 feet or more was driven, for the purpose of draining the mine to the low ground lying to the south of the deposit. There are also other shafts and pits, put down mainly for exploratory purposes.

As very little work has been done on this property since 1896, the workings are in bad shape, and thus did not allow of thorough examination as to the possibilities of the mine in case of resumption of work. However, from all the information which could be gathered, it would appear that the manganese ore is distributed very unevenly in the rock. From this fact it would seem unwarranted to go to great expense installing costly mining and concentrating machinery, since from the very nature of the deposits, it would be difficult to keep development work and blocking out the ore very much in advance of the actual mining.

Immediately to the west of the main excavation, an open-cut was made a few years ago, to test the continuity of the manganiferous formation in that direction. The rock uncovered here showed a reticulating network of small stringers, but no large pockets were struck.

Work on the Tennycape deposits was begun about 1860: and although it is difficult to get accurate figures of the total tonnage of ore which they yielded it is probably in the vicinity of 3,000 tons.

There are at the mine large dumps of refuse, which contain an appreciable proportion of manganese ore. The owners of the property are at present looking into the possibility of working over these dumps, and it is possible that a considerable quantity of manganese ore could be recovered at a cost which might be profitable.

Parker Mine.—The manganese deposit known as the Parker mine is situated three-quarters of a mile directly north of the Tennycape mine, in a small outlier of Carboniferous limestone detached from the main development, and completely surrounded by Devonian rocks. The workings consist of an excavation from which, according to different authorities, from 20 to 100 tons of good pyrolusite are said to have been mined and shipped in the early eighties. It was from this deposit that ore was extracted which sold for $140 a ton on the Boston market.

The pit is full of water and nothing can be seen, but the deposit is said to have been practically exhausted when work was abandoned.

Walton Deposits.—These deposits are situated near the contract between the Carboniferous and the Devonian, both to the east and west of Walton village, on the shore of Minas basin, at the mouth of Walton river.

The occurrences here are similar to the Tennycape ones, but none of the individual deposits discovered so far are as extensive. The manganese is found at the base of the Carboniferous limestone, which, however, appears to be less magnesian here than at Tennycape.

In numerous places along the contact between the limestone and the underlying Devonian shales and quartzites, pits have been dug on showings of manganese. Many of them go by the name of mines, but in the majority of cases the limited extent of the work done hardly warrants this designation.

The most extensive work has been done on the Stephens property and on the Churchill or Walton mine.

Stephens Property.—Mr. William Stephens has been carrying on work of a prospecting nature for some twenty years. This property is situated about three-quarters of a mile southwest of Walton village. The workings consist of a series of trenches and open-cuts, some of which are over 100 feet long by 40 to 50 feet wide, extending over a total length of some 1,200 feet. Two inclines, 60 and 70 feet long respectively, have been driven, and a shaft 40 feet deep is now being sunk. Small shipments of manganese ore are said to have been made from these places, but no large deposit has yet been encountered.

Walton or Churchill Mine.—This is a small, isolated outlier of limestone, lying a quarter of a mile north of the main development of Carboniferous rocks. Some comparatively large masses of pyrolusite and manganite have been mined from

this deposit by open cast work. The pit is now full of water, but the mine seems to have been pretty well exhausted of the visible ore at the time it was abandoned.

The main known occurrences of manganese ore in New Brunswick were next visited.

Markhamville Deposits.—These deposits occur near the contact of a small development of limestone with Pre-Cambrian rocks. The manganese ore is found in pockets and in reticulating veins, irregularly distributed in the limestone. The mine is situated at Markhamville, about nine miles in a straight line directly south of Sussex, in Kings county, New Brunswick. The workings consist of numerous open-cuts, trenches, a shaft and tunnels, scattered over an area of four or five acres. The limestone is probably slightly dolomitic, but effervesces very freely with cold, dilute hydrochloric acid.

Work was begun on the Markhamville deposits in the early sixties, and shipments of manganese ore were made, more or less regularly, during a period of twenty-eight years. Work was then abandoned after a rather careful prospection, which included the drilling of numerous diamond drill holes to depths of over 100 feet, in some cases. Presumably, the results of these explorations were not satisfactory. The ore was teamed to Sussex station, a distance of some fourteen miles by road, over very hilly country, and this was another of the great difficulties attending the working of this deposit. A rate of $2.50 per short ton for transporting the ore from the mine to the station was considered very low, and could be obtained only for comparatively large teaming contracts.

At one time, a well equipped plant for sorting, concentrating, and grading the ore was put up and used, but nothing of it now remains, even the buildings themselves having been removed.

The ore was high grade, although some second and third quality ores were also produced and shipped as blast furnace ore. However, owing to the irregularity of the deposits, and the difficulty of shipping, it is probable that the greater part of the profits was derived from the high grade ores, which brought high prices as compared with ores used in the manufacture of steel.

It is rather difficult to obtain accurate figures as to the total manganese ore mined at Markhamville, but as these mines were by far the most productive of the Canadian manganese deposits, it is safe to credit them with the greatest proportion of the total output of manganese ore from New Brunswick. A safe estimate would be about 20,000 short tons mined and marketed between the years 1865 and 1900.

Jordan Mountain.—The manganese deposits of Jordan mountain are situated five miles north of Sussex, in Kings county, New Brunswick. Although some limestone is said to be present in the immediate vicinity, the manganese ore is found in pockets and stringers in a conglomerate rock, made up largely of fragments of the underlying Pre-Cambrian beds. The distribution, however, is irregular, as in the case of the other known manganese ore deposits of the Maritime Provinces.

The Jordan Mountain deposits were discovered in 1882, and the workings, which occupy an area of a couple of acres, consist of an open-cut, about 100 feet long by 30 to 40 feet wide, and a shaft 40 feet deep, as well as shallow pits and trenches of an exploratory character.

From the available records of production, it would appear that the Jordan Mountain mine shipped between 400 and 500 tons of high grade ore between the years 1882 and 1900, although it is said that several thousand tons were extracted. There is at present at the mine a dump of comparatively good ore, containing in the vicinity of 250 tons, which could probably be shipped as blast furnace ore.

The nearest shipping point is Sussex station, on the Intercolonial railway, about six miles distant by a good road, which is down grade, except for a short stretch of a quarter of a mile or so, which is uphill.

Shepody Mountain Deposit.—Situated on the west side of Shepody mountain, in Albert county, at the base of a conglomerate of lower Carboniferous age. The ore consists of pyrolusite and psilomelane, distributed in irregular nodules and pockets. Work was begun at the mine in the early sixties, and carried on for some years. The workings consist of a main slope driven at an inclination of 45° in the side of a gully, in the bottom of which flows a small creek. This slope is said to be 250 feet long, and from it levels and cross-cuts have been driven. It is said that altogether over 1,800 lineal feet of driving have been done. These are now all caved in and cannot be entered.

No reliable data of the total quantity of manganese ore extracted from these workings are available, but it is said that some 1,600 tons were produced.

In a private report on this property by Mr. Francis D. Taylor, M.E., the probable cost of mining and preparing the ore for the market from this deposit is estimated at $15 a short ton, but the deposit is so irregular that it is difficult to arrive at anything approaching accuracy as to the cost of production in future operations.

Dawson Settlement.—There occurs at Dawson Settlement, five and a half miles northwest of Hillsborough, in Albert county, New Brunswick, a comparatively important deposit of wad, or bog manganese, which owes its origin to deposition by springs. This locality was visited in the fall of 1909, but only a short time was spent on the ground, and the following notes are mainly abstracts from previously published reports by Drs. Chalmers and Bailey, who both examined the locality in detail.

The deposit is situated on the west slope of the valley of Weldon creek, the opposite slope being occupied by Dawson Settlement. Over an area of eighteen or twenty acres, upon the removal of a thin coating of vegetable matter, usually not more than 2 inches in depth, a very fine black powdery deposit is uncovered, consisting essentially of manganese oxide. This deposit varies in depth from a few inches to more than 25 feet. From some seventy-three borings made a few years ago it was calculated that the deposit had an average depth of 6′-7¾″ over an area of seventeen acres. The weight of this material is about 1,900 pounds to the cubic yard. On this basis there would be available in the deposit about 175,000 tons of manganese ore.

It may be mentioned that the conditions here are ideal to establish an easy and cheap drainage system, and no difficulty would be encountered on the score of water. This is an important point, as in deposits of this nature the drainage is one of the main questions to be considered.

This deposit began to attract attention in 1887, and several attempts have been made to work it. At first, the ore was merely dried in kilns and shipped for the manufacture of ferro-manganese, but owing to its pulverulent state the product is said to have been very troublesome in the furnaces. In 1897, the Mineral Products Company erected a large plant for the drying of the ore and the manufacture of briquettes. These were shipped to Bridgeville, in Nova Scotia, to be used by the Preston Charcoal Iron Company in the manufacture of ferro-manganese. The enterprise was reported for a couple of years as being successful, when, for some unknown reason, work was completely abandoned, and the mine and briquetting plant have been idle since 1900.

It is said that the plant cost about $30,000, including the construction of a mile and a half of tramway connecting the mine with the Salisbury and Harvey railway.

There are at present several hundred tons of ore stored in the sheds near the briquetting plant, as well as several tons of the briquettes. Samples of each of these were secured and have been analysed by Mr. Connor, in the laboratory of the Mines Branch, with the following results:—

Analyses of Manganese Ore from Dawson Settlement, New Brunswick.

	Crude Ore.	Briquettes.
Metallic manganese	20·00	31·74
Silica	8·93	5·02
Iron	25·40	27·40
Phosphorus	0·17	0·16

The samples contain a comparatively large proportion of vegetable matter which was not determined.

CONCLUSIONS.

As may be gathered from the above notes, the manganese deposits of the Maritime Provinces are irregular and pockety. This is compensated for, to a certain extent, by the fact that the ores are very pure and applicable to the uses which require the greatest purity. During the active period of operation of the mines in Nova Scotia and New Brunswick, from 1865 to 1890, very high prices prevailed for this class of ore, some shipments having brought $140 a ton. Although this price was exceptional, yet the average was very high. It is a significant fact that when prices for high grades ores fell to $40 a ton on the Boston and New York markets, work was practically abandoned in the Maritime Provinces, presumably owing to the inability of profitably mining the ores at these prices. In this class of deposits, where the ore supply is uncertain, where it is difficult to keep development and exploratory work well ahead of the actual mining, and where a great deal of dead work may be necessary to reach or mine the 'pockets,' the cost per ton of ore prepared for shipment is liable to vary between wide limits, but is not likely to be low under the most favourable conditions. The nature of such deposits does not permit of the installation of plants for economic mining and handling cheaply large quantities of material.

It would, therefore, be well for any one intending to resume work on any of the deposits of manganese of the Maritime Provinces to proceed cautiously, and to look carefully into the questions of markets, prices, probable cost of mining, etc. The principal market for such Canadian ores would, in all probability, be the United States, and in this connexion it is interesting to quote the following from the 'Mineral Resources of the United States for the year 1908.':—

'The prices of manganese ores used in the steel industry vary from $5 to $15 per long ton, according to the grade of the ore. They are governed by the following schedule of prices established by the Carnegie Steel Company:

Schedule of prices paid per ton of 2,240 pounds for domestic manganese ore delivered at Pittsburgh or Bessemer, Pa., and South Chicago, Ill.

Prices are based on ores containing not more than 8 per cent silica or 0·25 per cent phosphorus, and are subject to deductions as follows: For each 1 per cent in excess of 8 per cent silica there shall be deduction of 15 cents per ton; fractions in proportion.

For each 0·02 per cent, or fraction thereof, in excess of 0·25 per cent phosphorus, there shall be a deduction of 2 cents per unit of manganese per ton.

Percentage of metallic manganese in ore.	Price per unit, in cents.	
	Manganese.	Iron.
Over 49	30	6
46 to 49	29	6
43 to 46	28	6
40 to 43	27	6

Ores containing less than 40 per cent manganese, or more than 12 per cent silica, or 0·27 per cent phosphorus are subject to acceptance or refusal at the buyer's option.

Settlements are based on analysis of sample dried at 212° F., the percentage of moisture in the sample as taken being deducted from the weight.

The manganese ores for oxidizing and colouring purposes are valued according to the quantity of manganese peroxide present; their consistency, etc., and prices range up to $25 per ton for the better grades of ore.'

In late years the immense deposits of manganese ore discovered in India, Russia, and Brazil have been supplying the greater part of the markets of the world, and some idea of the importance of this industry in the three countries mentioned may be gathered from the fact that in 1907 India produced 912,761 metric tons, valued at £911,943; Brazil, 236,778 metric tons, valued at £500,611; and in 1906 Russia produced 1,018,961 tons, valued at £423,964.

The following analyses of manganese ores from some of the Canadian deposits visited in 1909 have been taken from various sources:—

——	Metallic Manganese.	Iron.	Analyst.
Tennycape mines	60·05		Dr. How.
"	55·63		"
Markhamville	60·00	0·55	
"	62·40	0·75	
Jordan mountain	52·88	0·83	Otto Werth.
"	57·37		Pa. Steel Co.
Shepody mountain	51·96		Ledoux and Ricketts.
"	50·67		J. J. Donald.

IRON ORES, AND METALLURGICAL LIMESTONES OF NOVA SCOTIA—THIRD SEASON.

Dr. J. E. Woodman.

Acting under your instructions, several iron and limestone districts were examined, which it was not possible to visit during the season of 1908. Some time has also been occupied with office work in completion of the second volume of the report.

IRON ORES.

Sporadic occurrences in Halifax county were studied, none of which gave any promise. In northern Antigonish and eastern Pictou counties is a district, north of the Intercolonial railway and south of the Arisaig field, that may merit study. The ore is a bedded hematite, appearing to be of good grade in the specimens seen. It was impossible to secure a guide, and without one search for the ledges would have been futile; hence nothing is known at first hand as to the amount and distribution of the ore.

Pictou County.—The only extensive region of apparent importance not included in the previous year's work was Pictou county. The ores there may be divided roughly into four groups—contact pockets at the base of the lower Carboniferous limestone (Windsor series), veins of siderite in the Carboniferous, unimportant ankerite veins with specular hematite in the Devonian, and interbedded hematites, chiefly in the Silurian. The second may be dismissed with the statement that nowhere in Pictou county are ankerite veins known to be of commercial importance.

The contact pockets have been developed by a chain of mines east of the Intercolonial railway and along the branch line of the Nova Scotia Steel and Coal Company road, and chiefly in the vicinity of Springville and Bridgeville. All the known deposits have been worked out to the limit of profitable mining by the Nova Scotia Steel and Coal Company and abandoned in favour of their Newfoundland bedded hematites. But it is quite possible that other pockets may be found upon further exploration, and they should prove to be as high grade as those formerly worked.

The contact of the lowland rocks of the Windsor series with those of Ordovician and Silurian age forming the highlands is sinuous, the curves as outcropping on the present land surface being now large, now small, and with little if any rhythm of interval. For this reason prospecting for pockets that do not outcrop, or from which 'float' does not extend, is attended with uncertainty. In those portions of the contact that reach back as embayments into the oldland, the base of the Windsor series has often been replaced by a high grade limonite, locally botryoidal or stalactitic. Some occurrences or parts of them are high in manganese, some almost free. The iron replacement is possible only where a soluble rock, such as limestone, forms the basal member of the series. In form the pocket is a warped disc, concave upward and outward towards the lowland. The grade of the ore is shown by the following series of analyses from the J. W. Cameron mine at Bridgeville. No. 450 is a general sample of limonite on the dump, excluding the high grade, hard, black ore and the manganic ore; 451 is hard botryoidal limonite, and 452 selected manganic ore from 200 pounds collected from different parts of the dump.

—	Fe.	Insoluble.	Mn.	P.	S.	Loss on Ignition.
450	50·79	17·10	0·54	0·074	0 028	8·67
451	56·02	9·02	0·46	0·032	0·023	10·15
452	27·92	2·31	31·80	0·062	0·002	11·02

Pockets of this class cannot be depended upon for permanent supply under present industrial conditions, but would furnish good ore for mixing with bedded hematites if the latter should ever prove to be attractive enough in quantity and quality to justify re-establishing a smelting industry in Pictou county.

Much has been written about the bedded hematites of the Silurian in the early years of the study of Nova Scotian geology. It must be admitted that much of the optimism then exhibited must have been due to non-appreciation of the points wherein iron differs from other ores in its economics. That there is a large amount of hematite interstratified with the sediments in the uplands is certain. But, after many years of intermittent search, it has not proved to be so abundant or the continuity of its beds so great as was stated with positiveness by those who examined the region forty or fifty years ago. The country is much broken by faults, so that long stretches of unbroken ore are not expected. Much of the hematite is exceedingly lean and siliceous, and would not repay exploitation under present market conditions. Thus the Webster ore, from South McLellan mountain, runs in picked specimens from 23·80 to 41·42 Fe, the latter being the only analysis giving over 30 per cent. The Wentworth 'eighteen-foot bed' on Sutherland river gave 31·41 in a cross-section sample. The best seen was on the Sutherland-Meiklefield property, west of French river and east of the St. Mary road, where an oölitic red hematite occupies one or more thin beds. But this gave only from 41·58 to 43·61 Fe.

To sum up, there have been discovered as yet no bedded ores in this county that could be worked with profit at present, but there is every possibility of the presence of such deposits.

Much has been made by some early students of the region of the carbonate ores which occur in irregular vein-like deposits at several points. Aside, however, from the fact that spathic ores are now of little value, those of Pictou county are apparently very impure. The occurrences seen were of so low grade that no samples were taken.

LIMESTONES.

The work on limestones consisted in visiting isolated localities not seen in 1908, chiefly inland along the line of the Intercolonial railway. The rocks containing these belong to the Windsor series. In western Antigonish and eastern Pictou counties large areas are underlain by soluble rocks containing either gypsum or limestone. But the strata of the latter are thin and variable, and even though their outcrops are often close to the railway they appear to have no economic importance.

On the south and west flanks of the highlands of Pictou county the rocks that carry the limonite pockets described above also contain workable beds of dense limestone, some of which were extensively quarried at one time. Thus, east and north of Springville is a persistent limestone horizon which can be traced without a break for more than two miles. At the south end is the quarry from which formerly the Nova Scotia Steel and Coal Company procured the lime for its works at Ferrona. Samples of this bed were taken at various points within the two miles, none of which

gave less than 95·80 $CaCO_3$, or more than 2·66 insoluble matter. The working bed has a variable thickness, averaging at least 15 feet, and dips west at a low angle. In places it could not be quarried with profit, owing to the low topography.

West of the Intercolonial railway, especially back of Hopewell, are a number of thin but good limestones, all of which would be handicapped by a haulage of nearly or quite two miles to rail. At Dunbar's quarries, near Lorne, is the largest single deposit seen, and easily accessible to the railway; but averaging not less than 5·13 insoluble matter.

On the south shore of the Province, west of Halifax, are several isolated deposits of Carboniferous limestone, at least one of which is very promising as regards quality and shipping facilities. This constitutes the Lordly and adjoining properties at East river. The rock body is of considerable extent, and lies directly at the water's edge, but the landing is somewhat exposed. The insoluble matter of the samples taken runs from 0·88 to 3·72, with an average of 1·65 per cent.

MAGNETIC SURVEY OF SOME MINING LOCATIONS AT TIMAGAMI, ONT.

Einar Lindeman, M.E.

I

In May, 1909, the writer received instructions to make a magnetic survey of locations W. D. 341, E. T. W. 340, W. D. 324, and W. D. 351, which are situated north of the northeast arm of Lake Timagami, and from half a mile to one mile from Timagami station on the Timiskaming and Northern Ontario railway. The field work was commenced on May 27, and occupied about seven weeks, all the necessary help for the survey being provided by the owners of the claims. A base-line was cut out and chained, starting from the line between lots 339 and 340, 152 feet south of the northwest corner post of lot 340. The length of the base was 6,400 feet and its bearing N 65° E, roughly following the general strike of the formation. At right angles to this line and at intervals of every 50 feet cross lines were run. Magnetic observations of both the vertical and horizontal intensity were made at a distance of every 25 feet along these lines with the Thalen-Tiberg magnetometer.

By means of these observations it was possible to trace the iron formation through all the locations, even through intervening swamps, where no outcrops occur.

It was also possible to locate the richer and more continuous portions of the iron-bearing rocks, which are often separated from each other by leaner material, chiefly jasper and schists.

Maps showing the details of these magnetic observations are now being prepared and the results obtained will be incorporated on a separate map of the area.

CHARACTER OF THE IRON-BEARING FORMATION.

The iron formation of the locations is a siliceous magnetite, interbanded with variously coloured jasper, lying in and surrounded by sericite and chlorite schist of Keewatin age. The general strike of the formation is about N 65° E, with a steep dip towards the north.

In order to ascertain the iron content, ten samples were taken in different parts of the field, where strong magnetic attraction indicated the magnetite to be more concentrated. In each place, crossing the formation at right angles, two handfuls of material were taken for every foot, and made up into one sample; the width of the outcrops varying from 18 to 100 feet. The samples might, therefore, give a fair average of the iron content of the places they represent. The following analyses were made by Mr. H. Leverin of the Mines Branch:—

Sample.	Iron.	Insoluble Matter.	Sulphur.	Phosphorus.	Notes.
	Per cent.	Per cent.	Per cent.	Per cent.	
I.	21·3	68·7			Width of outcrop 40 feet.
II.	24·5	64·2			" 30 "
III.	22·6	66·2			" 35 "
IV.	27·2	59·8			" 100 "
V.	18·6	72·4			" 25 "
VI.	21·7	66·9			" 45 "
VII.	24·2	63·4			" 32 "
VIII.	23·2	66·0			" 18 "
IX.	23·6	63·3			" 32 "
X.	25·9	59·3			" 36 " 'T. B. Mine.'
XI.	38·8	41·3	0·160	0·096	Specimen of magnetite.

Thus, the assays of the ten samples give returns of metallic iron, ranging from 18·6 to 27·2 per cent and showing an average of 23·3 per cent.

The determinations of insoluble matter give an average of 65·02 per cent when the sulphur and phosphorus content, determined in two samples, ranges from 0·016 to 0·091 per cent of the former, and from 0·026 to 0·064 per cent of the latter. Sample XI is a piece of magnetite from one of the richer iron bands, in which no siliceous matter could be seen by the naked eye. The high percentage of insoluble matter shows, however, the extremely intimate association of the magnetite and silica.

In addition to the above-mentioned work, the greater part of the autumn was spent in the making of a special investigation of the iron ore deposits of the Bristol mine, situated in Pontiac county, north of the Ottawa river, Que. Particulars of this examination, including a magnetometric survey map and topographic map of the mine area; together with the results of Mr. Mackenzie's concentration tests of iron ores taken from the Bristol mine deposits—will, I understand, be published in bulletin form at an early date.

ON THE COPPER MINING INDUSTRY IN QUEBEC.

Alfred W. G. Wilson, Ph. D.

The summer season of 1909 was spent by the writer in studying the present status of the copper mining industry in the Province of Quebec. The occurrence of ores of copper was known in the Eastern Townships of Quebec as early as the year 1841, and the report of the Geological Survey for 1866 gives a list of 525 localities in which the minerals of copper had been found; yet at the present time there is but one shipping mine in active operation. During the ten years preceding 1866, the high price of copper, and the rich character of the ores found in a few localities, stimulated prospecting and mining. The subsequent decline in the price of copper from a maximum of 29·3 cents per pound in 1907, to about 9 cents in 1886, coupled with the fact that many of the deposits discovered were apparently soon exhausted, was a severe check to the industry—a check from which it has never fully recovered.

During the decade preceding 1885, several properties were opened, and even though the market price of copper was low, they were worked at a profit, because operated on a better economic basis. One of these properties has been in continuous operation ever since—the Eustis mine; while another—the Capelton mines—was only closed down about two years ago. In both instances profitable working of the mines seems to have been directly associated with the utilization of the sulphur content of the ores; better transportation facilities have also been an important factor in obtaining this result.

During the course of this investigation the writer has visited every locality about which any information could be obtained either from old reports or from personal interviews. In all about two hundred localities were visited. In some places no trace of the original discoveries could be found; in others the present occupant was not even aware that any copper minerals had ever been found in the locality, while in many instances the showing was such that the writer does not consider that any exploration work was ever justified. In those places where mining operations had been carried on, the old workings were usually full of water, and caved; while the old dumps were often overgrown with vegetation. Adjacent rock outcrops are usually small, and are more or less completely obscured by soil and vegetation. In the few instances where it has been possible to compare early reports with the actual condition, the writer has been compelled to recognize that the early reports must be largely discounted. In localities where access cannot be had to the old workings, and where surface indications are very meagre, the writer would hesitate to accept any statements with regard to the property in question in the absence of recent and adequate exploration.

The deposits of rich ores—the outcrops of which were located in the early days—were usually in the nature of pockets. In a few localities these pockets were of considerable size, but in the majority of cases they were small. These ore pockets were, however, very widespread throughout the copper-bearing rocks of the Eastern Townships, and there is every reason to believe that others may exist in the same district. The recently discovered McDonald mine, lot 22, range II. Weedon, is one of these; it is now in the course of development, and its size has yet to be determined.

There are several localities in the vicinity of old workings where further exploration by modern methods would be justified. Two of these can be specifically referred to at the present time:—

Harvey Hill.—At the old Harvey Hill mine one of the ore bodies was known as the 'interstratified bed.' This was a band of schists through which pyrite and chalcopyrite were disseminated—the band varied from 4 to about 7 feet in thickness, and yielded a rich concentrating ore. It is very probable not only that this impregnated zone may extend beyond the old workings, but that other quartz veins carrying the rich bornite ores which were so characteristic of Harvey Hill in the early days, may be discovered. The writer is of opinion that, the early miners removed all the valuable ore they could find from the Harvey Hill mines, and that if the old mines were re-opened, little ore would be found at the old faces, though low grade ores may have been left behind. This belief, however, does not militate against the possibility that the impregnated band extends laterally beyond the old workings and also below them. It must be noted that at the present time the old workings are all full of water and inaccessible.[1]

Sherbrooke District.—The other locality to which the writer would specifically refer at the present time, includes the district in the vicinity of the Eustis and Capel mines and extends on either side of it for at least two miles, if not further. The character and size of the ore bodies already located in this district, coupled with the fact that very little systematic exploration has been carried out, are such that, detailed scientific exploration is both justifiable and desirable. In fact, exploration of this character is also justified at a number of localities in the vicinity of several of the old mines which lie between this district and the Moulton Hill mine, northeast of Sherbrooke.

PROPERTIES IN OPERATION.

Eustis Mine.—At the present time the only copper mine in active operation is the Eustis mine, situated in the township of Ascot, about nine miles from Sherbrooke. The ore is pyrite, containing small amounts of chalcopyrite. The shipping ore contains from 40 to 45 per cent of sulphur, and usually less than 2 per cent of copper, with very small values in gold. The annual shipments, according to the report of the Quebec Department of Mines, are in the neighbourhood of 30,000 tons. The present management at the Eustis mine hope to largely increase this output in the near future. The mine is operated by electric power, generated on the Coaticook river, and the small water supply at times greatly handicaps operations at the mine.

A small portion of the Eustis ore is utilized at the chemical works in Capelton. The greater part of the ore is shipped out of Canada to various chemical works in the United States. The residues—after the extraction of the sulphur—are for the most part shipped to the smelter at Norfolk, Virginia, belonging to the principal owners of the Eustis company.

During the summer of 1909 prospecting and development work was carried on at a number of properties in the Eastern Townships.

Memphremagog Mine.—At the Memphremagog mine, about two miles from Knowlton landing, on Lake Memphremagog, a new shaft was sunk about 150 feet north of the old shaft. At the time the mine was visited (July) this shaft had passed through the ore, and was being sunk in the country rock near the contact between the diabase with which this ore is associated and the schists. The old shaft has also been unwatered and was being deepened. The ore is pyrrhotite, containing a very small amount of chalcopyrite, which usually appears as thin films along fracture planes. Near the south shaft the ore body has an extreme width of about 20 feet,

1. A detailed report on this property, dated May, 1899, by Mr. John Daw, jr., is on file at the Mines Branch office. Extracts from this report showing the underground conditions will appear in the report on the copper ores of Canada.

and a length, probably, of about 200 feet; the average width being about 12 feet. In the opinion of the writer, the total amount of ore, as shown by the workings at the time the mine was visited, will not be more than 20,000 tons; the copper content is very low, probably less than 2 per cent. Disseminated pyrite had been found in a number of pits and trenches to the north along the line of contact between the diabase and the schists, but no new ore bodies of commercial value had been discovered at the date when the mine was visited.

Hepburn Mine.—The Eustis Mining Company has installed a small hoist at the old Hepburn mine, lot 7, range II, Ascot, and is engaged in re-opening the mine. At the present time an ore band about 4 feet in width, carrying pyrite and chalcopyrite, has been exposed in the bottom of the old shaft.

Suffield Mine.—At the Suffield mine, development work, which has been in progress for three years, was still going forward. Here a very large volume of low-grade siliceous ore—pyrite and chalcopyrite—has been developed. This mine contains the largest amount of 'developed' ore in the Eastern Townships; but no shipments have been made in recent years. The ore is rich in silica and alumina, the sulphides being finely disseminated through a schistose rock consisting of quartz and sericite mica. For smelting purposes it will prove very refractory. The ore is very low grade, and while concentration is possible, the losses will be large on account of the fine state of division of much of the sulphides. This ore also contains small values in gold somewhat irregularly distributed; a small amount of silver is also found in many assays. Its value as a commercial ore under present conditions has yet to be proven.

On the adjacent property belonging to the same owner, the King mine, a considerable amount of ore has also been partially developed, but the mine is now full of water. The ore body shows almost pure sulphides; no data are available as to its size. The ore is richer in copper and carries more gold and silver than the ore of the Suffield. The owner of both properties is Mr. A. O. Norton, of Coaticook, Que.

McDonald Mine.—About seven miles by road, northeast of Weedon station, on lot 22, range II, Weedon, the East Canada Smelting Company is investigating a property known as the McDonald mine. In this locality a prospecting pit has been put down on a deposit of almost pure sulphides—pyrite and chalcopyrite: portions of the ore will assay high in copper. The development work has not proceeded far enough to disclose the size of the ore body, but the prospect is a promising one.

Ditchfield Mine.—A few hundred yards from Trudel siding on the Canadian Pacific railway, on lot 9, range VI, Ditchfield, almost six miles east of Lake Megantic, a small plant has been installed, and a shaft is being put down. The country rock is a mica-quartz schist. A small quantity of pyrite is present disseminated through a narrow band of the schists, but copper sulphides are practically absent. The writer could see nothing to justify any further expenditure in this locality.

Ducket Mine.—East of the Chaudiere river, in the Parish of St. Joseph, about one mile south of St. Joseph village, exploration work is being carried on. A shaft is being sunk on a small vein carrying irregular masses of chalcocite. The chalcocite masses are roughly lens-shaped, rarely over 2 inches in thickness. In sinking the shaft they have been found to pinch out and come in again, and none of any large size have been disclosed.

Turgeon Mine.—On the property adjoining the Ducket mine, on the south side of Galway creek, another pit is being sunk in a somewhat similar deposit. The country rock of the locality is a dark green serpentine, irregularly fractured, many of the fractures showing copper stains. No ore of consequence has been found, and the writer would hesitate to recommend further exploration on either property.

Actonvale Smelter.—At the present time a small smelter of about 40 tons capacity is being erected at the old Acton mine, lot 32, range III, Acton. The old dumps on

this property must contain approximately 50,000 tons of waste. So far as the writer can learn the dumps have never been sampled. They undoubtedly contain some copper, probably less than 1 per cent. A concentrating plant is to be erected later for treating the ore on these rock dumps. The rock associated with the copper ore is a dolomitic limestone, containing approximately 87 per cent calcium carbonate, and 10 per cent magnesium carbonate, with about 1·6 per cent insoluble matter, and the balance, oxides of iron and aluminium. Copper ore is present as chalcopyrite and bornite, the ore, as may be expected, being very irregularly distributed in the dumps. The plant is being erected by Pierre Tetreault, 407 Power Building, Craig street west, Montreal.

Types of Ores.—The types of ore which occur in the Eastern Townships may be classified on the basis of their composition as follows:—

Pyrite and chalcopyrite, nearly pure sulphides, the copper content varying from a mere trace to more than 12 per cent, as at Eustis, Capelton, and elsewhere.

Pyrite and chalcopyrite disseminated through a highly siliceous gangue, as at the Suffield mine.

Chalcopyrite and bornite disseminated through a calcareo-magnesian limestone, as at Actonvale and vicinity.

Bornite in a siliceous gangue, usually quartz, as at Harvey Hill.

Pyrrhotite containing a small amount of chalcopyrite, as at Memphremagog mine.

Chalcopyrite and pyrite with quartz, and associated with a basic igneous rock, as at the old mines near St. Flavien.

Chalcocite, in small amount, associated with quartz, and more rarely with serpentine, occurring in several localities, but relatively unimportant.

Developed Ore.—The Suffield mine is the only property in the district, except the Eustis, so developed that a steady output could be assured. The quantity of ore immediately available for stoping has not been estimated. The size and shape of the ore bodies is unknown, and the developed portions have not been systematically sampled since the development. The ore is rich in silica and alumina, is low grade, and will prove very difficult either to concentrate or smelt.

At the Eustis mine, although development work has proceeded far enough in advance of stoping to show that there is a very large body of ore in reserve, it would not be possible to make an accurate estimate of the reserves at the present time.

At several of the mines old dumps exist that contain large quantities of valuable ore. The old dumps of the Eustis mine are said to contain about 75,000 tons of waste. The richer portions of these dumps are now being put through the mill, and it is probable that over 25,000 tons of shipping ore will be recovered.

At the Albert and Capel mines there are large dumps. Much of this waste has already been treated by crushing and jigging. Portions of the dumps still contain good concentrating ore. On the same property, at the Crown mine dumps, there is also a small quantity of concentrating ore.

The dumps at the Ascot mine contain a small quantity of rich ore.

At Actonvale, large dumps also occur, containing a small quantity of rich ore.

These dumps have not been sampled or measured. The material composing them varies in size from fines to blocks containing 3 or 4 cubic feet. Many of them have been exposed to the atmosphere for many years, and much of the copper content may have been leached away. Several months would be required to sample them carefully, the expense would be very considerable, and it is not within the province of the Mines Branch to value the property of individuals.

STATEMENT OF GENERAL CONCLUSIONS.

Copper mining in Quebec has had a varied history. With the exception of two mines, at Eustis and at Capelton, it cannot be said to have ever been very successful. It is true that in a number of localities, notably at Harvey Hill and at Actonvale, pockets of very rich ores were found in the early days—but none of these deposits has ever produced a large tonnage, and most of them were soon exhausted. While it might be stated that lack of ore has been the chief cause for this lack of success, as a matter of fact it has never been demonstrated that this is the cause. The one surprising feature in connexion even with those mines that have been successfully operated is the extraordinarily small amount of scientific exploration that has been carried on. There has been almost no lateral exploration and no boring of consequence. Ore-bodies were found, the ore was mined out as it occurred, but there was almost no development work ahead of the mining. Periods of very reduced output followed periods of large output. At the present time in the Eustis mine development in the shaft is about 200 feet ahead of the lowest level from which ore is being mined, and four new drifts have been started from two new levels. Again at the Suffield mine, a comparatively large tonnage of low grade ore has been blocked out on four sides. This ore reserve has not been systematically sampled, and has not been surveyed, but it is undoubtedly the largest amount of developed ore available in the district. The writer is inclined to think that it will be found very difficult to recover the values in this ore, partly because of its siliceous nature, and partly because of the finely disseminated character of the sulphides, which will make it difficult to concentrate. So far as can be learned these are the only occasions in which development work to any extent has preceded mining. In the Eustis mine, the ore showings are probably the best in its history. In the Suffield, the value of the ore and a method of extracting these values at a profit have yet to be determined.

Apart from the natural depression which results from the low price of copper, the writer is strongly of the opinion that the present backward condition of the industry in Quebec is due to several other factors. One of the most important contributary factors is the attitude assumed by the majority of the owners of undeveloped and unexplored prospects. Until these prospects are properly investigated nothing can be known as to their value. In the greater number of cases the owners are not financially able to undertake the work themselves, nor have they the requisite knowledge. This very lack of knowledge, coupled with the absurd popular notions as to the value of a mineral prospect, which the owner usually assumes is already a mine, causes them to place an extraordinary valuation on undeveloped properties. Most of the owners not only will not assume any of the risks attendant on initial exploration, but ask such prices for their properties—in some cases not being willing even to have them adequately tested first—that capitalists experienced in copper mining have no choice but to leave the district. Could owners be made to understand that a copper mine does not consist of a few small showings of copper ores in the bottom of a small pit, that a mine has to be developed from a prospect by hard and continuous labour like any other industry, that in the majority of cases the assays which they have received from some commercial chemist, of specimens not independently collected, are no indication whatever of the actual content of their property—then, and then only, when owner will meet capitalist on the common ground of mutual interest, will it be possible for the interests of both to be so adjusted that the prospects themselves may be properly investigated.

Lack of a convenient market has also retarded the industry. The erection of a custom smelter at some central point in the district has been advocated as a solution of this difficulty. It is doubtless true that a custom smelter would enable small owners to obtain immediate returns from their ores. But from the standpoint of the smelter owner it is difficult to understand how he could expect to operate his

plant at a profit unless an adequate supply of suitable ores were assured. On various occasions small smelters have been erected at different localities to treat the ores of individual mines. Undoubtedly some of them were operated at a profit, but many were not, and in all cases the smelting costs were high and the plants could only be operated when the market price of copper was high. The high costs were in part due to the fact that usually the ore was all of the same type, being derived from one mine or group of mines, and when smelted alone it proved refractory. Had provision been made to obtain different types of ores from several localities so that a proper smelting mixture could have been obtained, costs would undoubtedly have been lower. Now, while a custom smelter centrally located could undoubtedly obtain some suitable ores from the district, at the present time no assurance whatever can be given that the supply will be constant, even for a limited period of time, nor can any accurate estimate be made of the quantity available.

A company proposing to erect a custom smelter should first assure itself of an adequate supply of suitable ores, and it would seem reasonable to this end that they should control several properties which would produce different classes of ore. The properties themselves should actually be opened up that the character of the ore may be known and a reasonable quantity be actually in sight, that is, developed on four sides. To a well-trained engineer or business man it may appear strange that it should even be necessary to make this statement, but the past history of mining and smelting ventures in the district repeatedly shows that the search for a commercial quantity of ore was the last step taken in the organization of such enterprises.

At the present time, in the absence of a suitable market, only the richer ores can be shipped to distant purchasers at a profit, and transportation charges consume a large portion of the values in the ore. The small owner, with little capital, cannot afford to do much development in advance of sales, and the profits are usually so small that it is hardly worth while investigating his property at all. On the other hand, the lack of an assured supply of ore renders the erection of a smelter a hazardous venture. These difficulties could be overcome by co-operation between the owners and capitalists, and the interests of both would be served.

There are a number of prospects known where there is a possibility of finding ore of value. These should be thoroughly investigated. When an adequate supply of ore is assured, then, and then only, will it be desirable to equip the mines with plants of suitable capacity. When the nature of the ores is known and an output of reasonable quantity is assured, it will be possible to devise a method of treatment and to design and erect a suitable plant at some convenient central point.

A POSSIBLE HOME MARKET FOR QUEBEC PYRITE ORES.

It is only within very recent years that many of our Canadian commercial organizations have recognized a principle that is almost fundamental to successful operation—that the profits which accrue in any enterprise are greatest when the same organization markets finished products—the source of raw material as well as the manufacture being controlled by the same organization. Where raw material or partially manufactured products are handed over to other firms for final treatment a very considerable portion of the total profits on the various operations is lost to the producer of the raw material, and incidentally the cost of preparing manufactured articles for the market is greatly increased. In practice it is not always possible to completely carry out this principle, but there are in Canada many industries where the recognition of the principle and its application within reasonable limits would result in many benefits not only to the properties most immediately concerned, but also to the country as a whole.

Where the diverse nature of manufactured products requires raw materials of different kinds derived from many different sources it is manifestly difficult, though not impossible, for any one industrial organization to control both the sources of

supply and the processes of manufacture. In such cases it is obvious, however, that co-operation between two or more great industrial organizations would undoubtedly lead to economies in production costs. This is especially true when the waste products of one industry are the raw material of another, and this happens to be the relation which exists between the copper and sulphur mining industry and the sulphite pulp industry.

During the summer of 1909, when driving through various sections of the Province of Quebec, covering a total distance in excess of 2,000 miles, the writer was particularly impressed with the very large amount of spruce pulpwood that was being prepared for shipment to the United States. The average price paid for this wood was about $7 per cord for wood free from bark delivered at the railway.

So great is the demand and so energetically have the farmers and others responded to this demand that large areas have been completely denuded of valuable trees. In a few localities some local residents have gone so far as to cut large spruce trees which were growing on the road allowance—these trees were actually the property of the municipality. In addition, much pulpwood has been cut on Crown lands. Statistics showing the total quantity of pulpwood exported from the Province of Quebec during the year 1909 are not available; it will probably total nearly 1,000,000 cords.

The following tables, compiled from the Trade and Navigation Reports, issued by the Department of Customs, will serve to indicate the volume of trade in pulpwood and wood pulp in and out of Canada. The data given are for the fiscal year which ends on March 31. No data are available showing the total home consumption of pulpwood and wood pulp.

Statement showing the Pulpwood Exported from Canada, 1907-8-9.

	1907.	1908.	1909.
Quantity in cords.	619,648	902,311	794,986
Value in dollars.	2,720,500 00	4,656,721 00	4,356,391 00
Value per cord "	4 39	5 16	5 48

Statement showing the Wood Pulp Exported from Canada, 1907-8-9.

	1907.		1908.			1909.		
	Quantity.	Value.	Quantity in cwt.	Value.	Value per ton.	Quantity in cwt.	Value.	Value per ton.
		$		$	$ cts.		$	$ cts.
Wood pulp chemically prepared		4,027,759	783,224	1,385,754	35 40	826,585	1,603,006	38 40
Wood pulp mechanically prepared			4,027,939	2,652,098	13 16	4,162,509	2,703,923	13 00

Statement showing the Value of Wood Pulp Imported into Canada, 1907-8-9.

Source.	1907.	1908.	1909.
	$	$	$
United States	33,435	56,416	31,173
Other countries	2,525	2,141	4,079
Total	35,960	58,557	35,252

It has recently been announced that it is the intention of the Quebec government to prohibit the export of the pulpwood from the Crown lands of the Provinces. This action is to be taken partly for the purpose of conserving the pulpwood resources and partly with the object of stimulating home manufacture. While it is very probable that the first effect of this legislation will be to greatly reduce the amount of wood exported, it seems altogether probable that eventually the home manufacturing industry will be greatly increased. No data are at hand to show the present Canadian home consumption of pulpwood and wood pulp. The tables on a previous page show that the amount of imported wood is small—though they do not indicate whether this pulp is chemically or mechanically prepared.

If anticipations are realized and a large home manufacture of wood pulp is maintained, at least a portion of this wood pulp will be chemically prepared. One of the most important of the chemically made pulps is that known as sulphite pulp. In the preparation of sulphite pulp by the methods at present in vogue in Canada about one ton of raw sulphur, costing about $22 per ton, is required for every 10 tons of sulphite pulp. It is possible, however, to prepare the sulphur dioxide required by this process from pyrite, or other ores containing a mixture of pyrite and chalcopyrite. In utilizing pyrite ores for this purpose some practical difficulties have been encountered because sulphur trioxide is usually formed at the same time as the dioxide. In chemical works the presence of the trioxide is more desirable than otherwise, but in pulp manufacture it is injurious. Commercial methods for preparing the pure dioxide from pyrite are available. In the United States there are two large mills in operation where ores of this character are being utilized for this purpose. Thus, there seems to be no reason, so far as the actual successful operation of a process is concerned, why Quebec sulphide ores could not be used in Quebec as a source of supply of sulphur for the preparation of sulphur dioxide to be used in the manufacture of sulphite pulp. There are also several plants in successful operation where sulphur dioxide is extracted from smelter fumes for the purpose of making sulphuric acid. If, in the future, conditions should warrant the erection of a smelter in the Province of Quebec, its location in a locality where the sulphur dioxide fumes could be utilized for other purposes would be in the interests of economical operation.

While it is not possible to give a detailed statement of actual operating costs, the following data, which are only tentatively submitted here, will serve to illustrate the possibilities of economical operation in this direction.

One cord of spruce pulpwood free from bark will produce about 2,350 pounds of mechanical wood pulp, worth, on the New York market, about $14 per ton. The same cord of pulpwood will produce about 100 pounds of sulphite pulp worth approximately $40 per ton. Hence, one cord of spruce pulp, which was worth $7 per cord on the railway in Quebec in the summer of 1909, when manufactured into mechanical pulp was worth $16.45; if manufactured into sulphite pulp, it would have been worth $22. At the present time there are no methods in use for conserving the large fraction of the pulpwood which is lost in the waste liquors from the sulphite pulp process; doubtless they will be discovered in the future.

To convert a cord of pulpwood into sulphite pulp about 100 pounds of sulphur are required, worth approximately $1.10. Assuming an ore containing 40 per cent recoverable sulphur, 0·125 tons of ore would furnish the equivalent amount of sulphur. At a market price of 10 cents per unit, the value of the sulphur content of this weight of ore would be about 53 cents[1], assuming that no sulphur trioxide is formed. In practice enough additional ore must be roasted to balance the sulphur trioxide losses. The cost of this additional quantity of ore and the cost of removing the trioxide must be taken into consideration. Exact data as to these costs are not available, but they will be relatively small.

[1] Note that if the ore contains 40 per cent recoverable sulphur, its sulphur assay will probably be between 42 per cent and 43 per cent, and payment is usually made on the assay sulphur, not on the recoverable sulphur.

Such additional costs as may accrue because of the more bulky nature of the ore, and because of the additional handling required, can also be paid out of the balance, in favour of using pyrite. As all this work can be done very cheaply and economically by mechanical means, there will still be left a very large margin of profit in favour of pyrite ore as against raw sulphur. Moreover, the cinder residues, after roasting, can all be utilized. If there is a copper content it can be recovered by leaching. The iron content can be used directly, or after briquetting, in a variety of ways. Ferro-silicon can be produced in an electric furnace—(the market for this product is, however, overstocked at the present time). As a source of iron ore these residues will always be in demand. Hence their value should be more than sufficient to pay the additional charges involved in the handling of pyrite ore and its residues when extracting the sulphur content by a roasting process. If the sulphur content of the ores can be utilized nearer their point of production, there will also be, for the miner, a saving in transportation costs.

If subsequent investigations should warrant the establishment of a smelting industry primarily to recover the copper and precious metals in the ores, a very considerable portion of the waste sulphur dioxide gases could be economically utilized in a sulphite pulp mill. The relative capacities of the two plants, and the character of the ores will determine whether the whole of the sulphur could be thus economically conserved.

A sulphite pulp mill of 100 tons per day capacity could only utilize the sulphur fumes from about 25 tons of ore containing 40 per cent recoverable sulphur, or about 50 tons of ore containing 20 per cent recoverable sulphur. A smelter of 50 tons daily capacity is, of course, a small affair. A large smelting industry would probably have to provide other means for utilizing a portion of the otherwise waste sulphur. In some localities, notably Tennessee, this is done by manufacturing sulphuric acid, the acid in turn being utilized for the manufacture of fertilizers. At the present time it is improbable that the Canadian market can absorb an increased output of acid. It is also an expensive product to transport and it is very doubtful if an additional output from Canadian centres could be marketed at a profit. It is probable, however, that in the near future the farming population of the Eastern Townships of Quebec, as a whole, will begin to appreciate the value of modern scientific methods of farming. When the recognition comes there will be a large home market for mineral fertilizers. An enterprising industrial corporation will usually find it advantageous to work up a home market for its by-products and to create an active demand by a judicious educational campaign. At the present time both Ontario and Quebec offer a very promising field for a campaign of this sort.

It is probable that in the near future economical commercial methods will be devised whereby sulphur can be extracted from the sulphur dioxide by-product gases of a smeltery. Certain laboratory reactions are already known which afford hopes that this expectation will be realized. Sulphur dioxide gas cannot be shipped in quantity economically even in liquid form in iron cylinders, the combined weight of liquid and container being nearly the same as that of an equivalent quantity of raw ore, while it is more difficult to prepare for transportation because the gas has first to be condensed under pressure. It can probably be handled economically in liquid form in tank cars. Sulphur can easily be handled, and possibly can be produced at less cost than the natural sulphur now on the market.

In conclusion it may be stated that if a portion of Quebec copper-sulphur ores is utilized in the district where they are produced for the manufacture of sulphite pulp or for any other purpose, the mine owners will not be the only persons benefited. At the present time a very considerable percentage of the value of the ore is paid out for transportation, chiefly through a foreign country. Most of this will be saved: not, however, at the expense of the railways, because the higher freight rates on the finished products of a sulphite pulp mill will more than compensate for

the small decrease in freight on raw ores. A large portion of the increased value of the material, when marketed as a finished product, will go to the mill operatives. This in turn will benefit that portion of the population which is engaged in producing food products. In brief, under present conditions, a very large percentage of the value of the finished products made from raw materials produced in Quebec, benefits other districts, and people not residents of that Province; the imperative demand which exists for products which are being manufactured from these raw materials ensures a large and ready market if these materials are converted into finished products in their home district.

NICOLET ANTIMONY MINE.

Under special instructions, a visit was made to the old antimony mine on lot 56, range I, South Ham. The old workings were not accessible, because the adit was blocked by clay and water, and the shafts were partly filled with snow and ice. As far as could be ascertained from a surface examination, the ore consists of metallic antimony, together with stibnite, and smaller amounts of other antimony-bearing minerals. The associated rock is chloritic schist, striking nearly northeast, in which numerous lenses of quartz, usually almost black in colour, are found. In width these vary from narrow veins to lenses about 2 feet across. In the vicinity of the mine the quartz veins examined were all characterized by swells and rolls—narrowing to one-quarter of an inch, or even disappearing, or widening to 2 or 3 inches.

In the vicinity of the old mine-workings the rocks are pretty well shattered by joints, and there appears to have been a slight jostling of the joint blocks: the cavities thus formed have been filled with quartz. Such veins are very irregular in both dip and strike; presumably, some of the spaces which they now occupy were open spaces when the vein matter was introduced, because some of the quartz veins show comb structures. Originally, also, there appear to have been bands of sulphides (iron and possible copper) between the quartz bands. In a vein 1 inch wide, six bands of quartz and five bands of red oxide of iron were noted: the latter about 25 per cent of the whole. Occasional vugs lined with quartz crystals, and containing crystals of antimony minerals, stibnite (Sb_2S_3), kermesite ($2Sb_2S_3.Sb_2O_3$), and senarmontite (Sb_2O_3) still exist. Stibnite was noted both in plate-like crystals, and in minute acicular crystals. Kermesite in small tufts of acicular crystals, and more rarely, a yellow tinted senarmontite, occur. In a few instances metallic particles were found in the quartz of the veins. In the rock adjacent to the veins more abundant metallics were noted, and on breaking the rock a large proportion of the metallics are seen to be distributed as thin plates along fracture planes—in some places producing a bright metallic lustre over a considerable area. Metallics in thicker particles also occur scattered through the rock. The ore in the rock seems to be most abundant near the veins. In many places, through the zone supposed to be mineral bearing, no visible particles of ore could be found. In some places impregnated rock was found adjacent to a fracture in which no quartz occurs.

The strike of the structural planes of the schists lies between N 40° E and N 50° E magnetic, or, towards the ridge which lies north of the mine, and the front of which runs nearly east and west. The presence of a waste cover makes it impossible to study the area for any distance along the strike. The prospecting work has all been along the face of the hill, or nearly at right angles to the strike. Between the most easterly shaft and the most westerly one, the distance is nearly 300 yards. Prospecting pits are to be found for some distance west of the main shaft, and much costeaning has been done.

North of the shafts the hill referred to above forms a dome-like ridge about a quarter of a mile in length. It is composed of basic plutonic rock, now serpentine on the side next the schists, but consisting of a diabase on the north side. About 850 feet southeast of the east end of this ridge is another similar but smaller dome.

Nearly half a mile south of the shafts—on the opposite side of a valley—lies a large area of serpentine rocks, which gradually pass into diabase farther south. The two small dome-like ridges in the immediate vicinity of the mine carry included fragments of schists in the upper surface, and they were probably forced into the schists as laccolithic masses from below. This circumstance makes it extremely probable that the band of schists has no great depth.

The mineralized area or zone lies close to the contact between the schists and the intruded serpentines. It is thus probable that other mineralized areas may occur in the same district along the line of contact. While the shape of the intruded masses makes it possible that the ore-bearing band may be of no great depth, there are no data at present obtainable from which it would be possible to determine what that depth is. On the other hand, it is also possible that the mineralized zone may follow the supposed curved surface of contact between the schists and serpentine and that a very considerable area beneath the schists may carry antimony minerals.

In 1881 there were two shafts on the property, 60 feet and 100 feet in depth, respectively, and 250 feet of drifting. Assays of the ores as they occurred in these shafts and drifts are said to have shown from 5 to 7 per cent of antimony. A small experimental plant was in operation in that year. The ore was crushed by stamps and then washed upon a broad travelling belt, the lighter particles being washed off, while the heavier were deposited at the end of the belt. This plan does not appear to have been very efficient and the losses in the tailings were high.

A number of small trial shipments were made from the property in 1881. The returns from these shipments show an antimony content of about 7 per cent. Experimental work on a Krom machine produced concentrates assaying from 30 per cent to 49 per cent antimony, in different experiments. In one case, what are called 'extra concentrates' were obtained—assaying 53·9 per cent antimony. Concentrates on a Hastings machine assayed 37·13 per cent. The ore was found to contain about 4 ounces of silver to the ton of 2,000 pounds. No gold has been reported.

In 1886, the property was purchased by Dr. James Reed. Under his control an adit was driven into the side of the hill to cut the deeper shaft near the bottom. This adit is about 304 feet in length. A small amount of drifting was done in later years, but no information is now available as to the results obtained.

The thin plate-like character of the particles of metallic antimony, as seen on the fracture planes of the rock near the surface, undoubtedly will make concentration difficult. While the concentration experiments made on the ore from the drifts and shafts seem to have yielded a product that is commercially valuable, no data whatever are available as to the costs. Nothing can be learned about the quantity of rock handled in obtaining this ore, and the weight of the ore mined is not known. Further information is needed with respect to the underground conditions; the surface showings are not of commercial importance.

SPALDING IRON LOCATIONS.

Some deposits containing hematite and magnetite have recently been found in the township of Spalding, about seventeen miles from Lake Megantic. At present the prospect can be reached by driving fourteen miles from Lake Megantic to an old mill located on lot 16, range VII, Spalding township, the last mile or so of the drive being through the fields over an old lumber road. From this point the distance to the prospects is about two and one-half miles, by old lumber roads that can be driven over in winter. The prospects are located in the midst of a dense wood and would be difficult to find without guides.

At the prospects the surface is covered with soil, leaves, moss, and roots, only a few outcrops can be found, and exploration will have to be carried out by stripping and drilling, provided it can be shown that this is worth while. A fairly commodious

log shanty has been erected near one group of prospects, near the east corner of lot 10, range VIII.

In this group of prospects, banded quartz, stained red with hematite or black with magnetite, and closely resembling in general appearance the banded jasper of western Ontario, is found in several outcrops. These outcrops are usually in the form of low domes, elongated in the direction of the strike, approximately N 40° E.

Considering the outcrops in order from southeast to northwest:—

The most southeastern outcrop occurs on lot 11, range IX. The rock has been exposed by stripping over an area about 50 feet long by 6 feet wide. It consists of banded quartz irregularly streaked white and red, with occasional bands of black magnetite—a dark red colour predominating. No ore of consequence was seen, and the actual size of the band of iron range rock is uncertain.

The next band occurs about 200 yards northwest of this, on lot 10, range IX, near the northwest line of the lot. It is probably about 20 feet wide, and the structural planes dip towards the northwest at about 70°. Both hematite and magnetite occur with the quartz in this outcrop, the iron range rock being a mixture of the two ores with quartz—some of the ore bands are nearly 2 inches in width; but by far the greater portion of the outcrop is quartz. On the northwest side of the outcrop the iron range rock is seen in actual contact with the adjacent country rock—a green schist. The inter-relations of the two suggest that the schist has first come into contact with the iron range rock as an intrusive, though this relationship is not proven.

About 100 yards farther northwest a number of large loose blocks of banded jasper, mottled red and white—red predominating—show that another band probably exists in this locality, in the east corner of lot 10, range VIII. No stripping has been done, and no ore can be seen. This band has a minimum width of 30 feet. On the east side of this band is an outcrop of grey schist, slightly different in appearance from the schist first found in contact with the second band of iron formation. About 50 yards northwest, a fourth band of iron formation, with a minimum width of 6 feet, has been uncovered in several places. No ore can be seen. This last outcrop is within 50 yards of the camp. Northeast about 250 yards, on lot 9, range IX, there are several outcrops of green schist.

There are thus at least four bands of iron range rock in this locality, separated by bands of green chloritic schists. Very extensive stripping will be required to determine the size of these bands. The fact that some of them contain narrow bands of good iron ore does not necessarily imply that concentrations of similar ore in commercial quantities occur in the locality. No commercial ore has been found, and assays of fragments from the ore bands in these rocks are not only greatly misleading, but their cost is an unnecessary expenditure.

Nearly half a mile northeast of the camp on lot 7, range VIII, near the southeast end of the lot, other iron range rocks have been found. The rocks form the southwest side of the valley of Fox creek.

The rock itself is a quartzite impregnated with magnetite, an assay of the rock showing over 15 per cent iron oxide. In this quartzite richer seams of magnetite and small clear quartz veins occur. The outcrops are found along the face of a steep slope, which in places becomes a cliff. The rock is greatly metamorphosed, and breaks up readily into large thin plates; the structures are nearly vertical and the strike is approximately northeast. The quartzite itself has been mistaken for iron ore; but no commercial ore had been found at the time of my visit.

The character of this last deposit makes it a very easy matter to determine the length and width of the magnetite-bearing body of quartzite, and to determine if concentration of the magnetite has occurred in any place along the iron range. In the case of the other bands of iron range a trial would be required to determine if they carry sufficient magnetite to render magnetometric methods serviceable in ascertain-

ing their nature and extent. Blind exploration of these deposits, without preliminary investigations by the latest scientific methods, is a waste of time and money. From the evidence at present available, no one can say whether iron ores in commercial quantity occur in this vicinity.

II

NOTES ON AN OCCURRENCE OF TALC AND SOAPSTONE IN MEGANTIC COUNTY, QUEBEC.

Talc has been found on lots 1 and 2, Craigs Road Range (in range VII, of Ireland) and also on lot 1, range I of the adjoining township of Inverness. The greater portion of the district in the vicinity of these discoveries is obscured by a heavy soil cover, though there are numerous rock exposures on the southwest part of the lots in the Craigs Road Range. It is probable that further investigation will show the existence of talc on other portions of these and adjoining properties.

Massive soapstone of a greenish-grey tint occurs in all the discoveries. On lot 1, range I, of Inverness, two pits about 4 and 12 feet in depth, respectively, have been dug. On Craigs Road Range lots, similar soapstone has been found in at least five localities, and a little excavation work has been done. In neither locality is the work sufficient to demonstrate the extent and character of the deposit. On the Craigs Road lots the soapstone appears to occur along a series of shear zones in a highly altered basic igneous rock, now largely chlorite, originally, possibly, a diabase.

The Craigs Road property also shows a number of veins of sea-green crystalline talc traversing the soapstone in several directions. These veins vary in width from about half an inch to over 4 inches. In length, individual veins have been traced for 12 feet or more; but their extent and distribution is not at present known. A crystalline rhombic carbonate—probably dolomite, is found in these veins, associated with the crystalline talc. Occasionally, masses of the carbonate and talc more than a cubic foot in volume are found.

The locality is about thirteen miles from Black Lake station on the Quebec Central railway, and about two and a half miles from the proposed location of the new railway between Levis and Sherbrooke, via Lloyd's mills. Lot 1, range I, Inverness is the property of R. J. Briggs, Clapham, Que., and lots 1 and 2, Craigs Road Range, Ireland township, are under the joint ownership of C. V. M. Temple, 175 Spadina Road, Toronto, Charles Campbell, Woodside, Que., and W. J. Porter, Clapham, Que., Mr. Temple having the control of the property.

These properties are deserving of careful and systematic exploration, to determine the nature and extent of the deposit.

ON A NUMBER OF IRON ORE PROPERTIES IN NORTHEASTERN ONTARIO.

Howells Fréchette, M.Sc.

WHITE LAKE.

Certain lots on the east side of White lake have been reported at various times as showing hematite. These lots were visited and searched. Even with the aid of men familiar with this section of the country, only a few showings of iron ore could be found. Among the reputed deposits not found was one mentioned by Dr. Ells, on page 64 J, of the Geological Survey Report, 1901, as the Robertson mine, on lot 1, concession I. of Bagot township, Renfrew county.

FAHEY OR BELL MINE.

The Fahey mine is situated on lot 26, concession XI. of Darling township, Lanark county, about 1,000 feet east of the shore of White lake. A shaft had been sunk into a vein of hematite ore to a depth of a little over 20 feet, but at the time of my visit was full of water. There were also some old trenches across the vein. These were cleared out and several new trenches were dug.

The ore was exposed in a trench 40 feet northeast of the shaft, showing the vein to be 15 feet wide, and in another 50 feet southwest of the shaft the vein was uncovered for a width of 10 feet, without touching either wall. Beyond these two trenches the ore could not be reached on account of the nature of the covering. The vein strikes N 40° E', and is almost vertical. Both walls are crystalline limestone. The ore is of uniform character, high in lime and low in silica, sulphur, and phosphorus. This would be an excellent ore for mixing purposes.

An average sample, taken from the ore pile at the old shaft, gives the following analysis:—

	Per cent.
Insoluble	2·44
Iron	34·73
Phosphorus	0·029
Sulphur	0·054
Lime	20·30
Manganese	0·32
Magnesia	3·44

About one and one-eighth miles southwest of the Fahey pit, an iron-bearing zone is encountered, the general strike of which is N 23° E. This was traced for about one mile.

The northernmost exposure is about 1,000 feet northeast of the line between concessions XI and XII, on lot 23, where a banded ferruginous and highly siliceous rock is exposed on the face of a hill for a width of about 35 feet. In this are small veins of hematite not exceeding 4" wide.

The following is a partial analysis of this ferruginous rock:—

	Per cent.
Insoluble	35·7
Iron	17·0

All bearings indicated in this report— unless otherwise stated—are astronomical

Following along the strike other outcroppings were found at 125 feet, 625 feet, 1,200 feet, 1,500 feet, and 3,000 feet from the above-mentioned outcrop.

Samples taken at the two last-mentioned outcrops give the following percentage for insoluble matter and iron:—

	Per cent.
Insoluble	60·00
Iron	12·40

and

Insoluble	54·52
Iron	3·90

The width at these two points was about 30 feet.

LOT 23, CONCESSION XI, DARLING.

Eleven hundred and fifty feet southwest from the last-mentioned exposure, a pit had been sunk about 7 feet into hematite, at a point where a vein had been enlarged by the crossing of another small vein. The body at this point is about 30 feet by 35 feet. The vein itself is only 2 feet wide.

An average sample gives the following analysis:—

	Per cent.
Insoluble	3·20
Iron	62·52
Phosphorus	0·44
Sulphur	0·004

Following in a direction S 35° W small veins of hematite are found at several points for a distance of 1,400 feet, and also along the same line on the opposite side of a small bay of White lake. A sample taken from a 2 ft. vein at this point gives the following analysis:—

	Per cent.
Insoluble	9·51
Iron	60·10
Phosphorus	0·127
Sulphur	0·035

YUILL MINE.

This mine is situated on the southwest half of lot 25, concession V, of Darling township; about one mile and a half south of the head of White lake.

Since 1889, when this property was first operated, a little over 2,000 tons of high grade magnetite have been mined.

This pit is about 100 feet long, by, from 30 to 40 feet wide, and a little over 70 feet deep. It was impossible to make a satisfactory examination of the pit owing to the presence of about 30 feet of water. At the east end, near the water level, ore can be seen—about 6 feet wide; while at the west end, there is a face of ore about 10 feet in width.

The ore body dips steeply to the south, having a foot-wall of diorite and schist, and a hanging-wall of crystalline limestone. Small veins of pyrites occur in the ore, but in a manner easily separated by hand picking.

Magnetometric readings taken in the vicinity of the mine do not indicate the presence of nearby deposits, nor the extension of the ore body in which the mine is located.

A sample from the mine and from the ore dumps gives the following analysis:—

	Per cent.
Insoluble	10·08
Iron	63·00
Phosphorus	0·025
Sulphur	0·006

PROPERTIES ON THE DARLING ROAD.

A number of lots were examined on both sides of the Darling road, in the south-western end of the township of Darling, Lanark county. These lots have been reported as showing iron ores. Most of the prospecting was done from twenty to thirty years ago, and in a number of cases the finds had not been visited since then.

Owing to the roughness of the country, and the great changes due to forest fires and dense second growth, it was difficult, and in a few cases impossible, to find these occurrences.

Lot 20, Concessions IV and V, Darling Township.

On the top of a range of hills, which crosses the northeast end of lot 20, concession IV, the amphibolite rocks were found to be impregnated with magnetite; but a magnetometric survey shows the impregnation to be very irregular, hence it cannot be considered of commercial importance: although the amount of iron reaches 50 per cent. or more, in places.

To the north of this, on the lower ground, a magnetometric survey was made, extending onto lot 20, concession V. This shows several large areas of moderately high readings.

The ore is not a well-defined mass, but merely an enrichment of the magnetite in the amphibolite rocks. The dimensions of the workable ore body can only, after carefully studying the analyses of a great number of samples taken at close intervals over the deposit, be arrived at by considering the market value of the ore and the cost of mining and concentrating.

The ore is too low-grade for direct reduction, so would have to be subjected to magnetic concentration.

Two general samples taken from the surface give the following analyses:—

	Per cent.
Insoluble	53·00
Iron	24·21
Phosphorus	0·468
Sulphur	0·031

and

Insoluble	54·11
Iron	23·70
Phosphorus	0·437
Sulphur	0·091
Titanic acid	0·69

Lot 22, Concession IV, Darling Township.

On lot 22, concession IV, several pits have been opened on small pockets of magnetite, and some ore shipped; but judging from magnetometric readings, these deposits cannot be considered of any importance.

Lot 22, Concession V, Darling Township.

A pit, said to be on lot 22, concession V, was visited and examined.

This pit had been sunk to a depth of about 20 feet into a small pocket of fine-grained magnetite with a small vein leading to it.

The following analysis is from a picked sample:—

Insoluble	8·34
Iron	61·17
Phosphorus	0·046
Sulphur	0·042

Lot 22, Concession III, Darling Township.

Southwest of the Darling road, on the southwest half of lot 22, concession III, is a large hill covered with broken rock and sandy soil. Some of these rocks show a considerable percentage of magnetite disseminated through them.

Along the north side of this hill, there are a number of large trenches which were opened about seventeen years ago and from which ore was shipped. These trenches have caved in and trees are now growing in the bottom of some of them. No reliable information could be obtained as to whether the ore came from loose fragments or from the solid formation.

Magnetometric readings taken in the vicinity of these trenches were low and irregular, and do not indicate the presence of a large body of magnetite.

On the opposite side of the Darling road, on the northeast half of the same lot, a pit was recently opened on a small pocket of magnetite.

Lot 17, Concession II, Darling Township.

At the northeast end of lot 17, concession II, is a high hill of amphibolite which extends across the lot. The rocks of this hill are impregnated in a great many places with magnetite, the richness varying from mere traces to a fair grade of ore. At the west end of the hill magnetometric readings indicate the presence of a fairly large and continuous body of low grade ore, which would require magnetic concentration. No satisfactory sample could be obtained at this point. The iron would probably run about 30 per cent.

To the southwest of the hill traces of hematite were observed in the neighbourhood of crystalline limestone.

Lot 18, Concession XI, Bagot Township, Renfrew County.

On lot 18, concession XI of Bagot, in the village of Calabogie, magnetic disturbance was observed near the main road which follows the west shore of Calabogie lake.

A magnetometric survey was made which indicates the existence of magnetite in a series of small pockets extending for about 600 feet along the road and crossing it.

Lot 18, Concession IX, Bagot Township.

On lot 18, concession IX, about two miles by road from the last-mentioned deposits, several pits have been sunk into iron ore.

At the extreme northeast end of this lot a pit had been opened in the side of a small hill. It shows a vein of magnetite ranging from 1½ to 3 feet in thickness, dipping to the south at 35°. Both walls are of crystalline limestone. The magnetite is mixed with hematite.

Thirty feet south of this pit a shaft had been sunk, but owing to the presence of water it could not be examined. The magnetic attraction in the vicinity was not great.

About one-third of the distance along this lot another shaft had been sunk. This was examined, showing the ore to be hematite, containing a little magnetite. The ore is much intermixed with rock, and is only 2 or 3 feet in thickness.

The ore is in crystalline limestone, underlain by quartzite and fine-grained hornblende schist.

At the southwest end of this lot there are also showings of magnetite and hematite.

Lot 23, Concessions V and VI, Bagot Township.

A magnetometric survey was made on parts of lot 23, concession V, and lot 23, concession VI, where some prospecting had been done.

The readings indicate the presence of a number of small bodies of magnetite, dipping very slightly to the south, the maximum thickness being about 6 feet.

A sample taken from various parts of these deposits gives the following analysis:—

	Per cent.
Insoluble	37·08
Iron	31·02
Sulphur	0·167
Phosphorus	0·312

Lot 28, Concession VI, Bagot Township.

On lot 28, concession VI, to the southeast side of the road which runs through that lot, a pit had been sunk to a depth of 18 feet into magnetite. The ore is found in alternating layers of high grade magnetite and a gneissic rock carrying magnetite. It dips to the south at about 15°. In the pit the ore is exposed for a thickness of 8 feet, but the foot-wall was not uncovered.

About 100 feet to the east of the pit there is a mass of gneiss; and to the north, a large exposure of crystalline limestone.

No magnetometric survey was made.

The following analysis is from an average sample taken in the pit:—

	Per cent.
Insoluble	38.00
Iron	42·81
Phosphorus	0·006
Sulphur	0·068
Titanic acid	1·37

Lot 13, Concession I, Blithfield Township, Renfrew County.

On lot 13, concession I, of Blithfield, about three miles south of Calabogie, in a side rockcut of the Kingston and Pembroke railway, a vein of magnetite, dipping at 35° to the east, is exposed for about 75 feet in length and 8 feet in height, without showing the foot-wall.

The face of the rockcut is a little over 50 feet high, with a rising hill to the east. On this hill the magnetic attraction is weak; but numerous readings taken along the edge of the swamp to the west of the railway, and in some places as much as 200 feet from it, varied from −17 to −22 degrees.

More readings could not be taken on account of the swamp.

An average sample of the exposed portion of the vein gives the following analysis:—

	Per cent.
Insoluble	37·40
Iron	38·80
Phosphorus	0·013
Sulphur	0·179
Titanic acid	4·96

South Canonto Township, Frontenac County.

On lot 26, concession VI, near the line dividing concession V and concession VI, a pit had been opened on a vein of magnetite. At the time of my visit it was full of water. An outcrop near the pit shows the ore to be fairly free from intermixed rock. A sample taken from a small pile of ore near the pit gives the following analysis:—

	Per cent.
Insoluble	31·60
Iron	44·00
Phosphorus	0·045
Sulphur	0·436
Lime	0·70
Titanic acid	trace.
Manganese	0·10

The vein which runs north-south was traced by means of the mining compass for about 250 feet onto lot 26, concession V. It appears to be about 10 feet in width.

Several hundred yards from the pit, another smaller vein was also seen.

In addition to the lots already mentioned, thirty-four other lots were visited and examined, twenty-eight of which were examined for iron ores. These are not commented on in this report for the following reasons:—

(1) From one cause or another the reported occurrences could not be located.

(2) The reported ores turned out to be some worthless mineral or rock.

(3) Only mere traces of ore could be found.

(4) Where the lots were examined for extension of a series of deposits and no discovery made.

(5) Where mines reported on by Mr. Ingall in his report on the iron ores along the Kingston and Pembroke railway were visited and no additional information was obtained.

MARBLE.

Two lots, namely, lot 6, concession III, and lot 7, concession IV, Darling, were visited to obtain data of the marble workings for the Division of Mineral Resources and Statistics.

PYRITES.

Lot 5, concession IV, Darling, was visited. Here a mine had been worked some ten years ago for pyrites.

The vein is almost vertical, about 8 feet wide and running northeast and southwest; the east wall of which is amphibolite and the west wall crystalline limestone. It was impossible to determine the length of the vein without digging deep trenches. A tunnel runs along the vein for about 100 feet.

CELESTITE.

Lot 7, concession X, Bagot, was visited and a deposit of celestite examined. The celestite occurs in a vein running northeast and southwest. It was traced for 500 feet; its maximum width is about 18 feet.

The vein seems to be free from included rock and impurities. The following analysis is from a sample from this vein, recorded in the Geological Survey Annual Report (New Series), Vol. XI, page 9 R.

	Per cent.
Sulphuric anhydride (SO_3)	42·09
Strontia (SrO)	48·30
Baryta (BaO)	9·44
Lime (CaO)	Trace.

In conclusion the author wishes to express his obligation to Mr. R.R. MacGregor, of Calabogie, Mr. J. Stewart, of Waba, and Mr. J. Bell, of Arnprior, who kindly furnished information and otherwise aided in the prosecution of the work. During the field work he was ably assisted by Mr. L. H. S. Pereira, of the staff of the Mines Branch, Department of Mines.

ON THE GYPSUM RESOURCES OF NOVA SCOTIA.

W. F. Jennison, M.E.

During the year 1909, I continued my work of investigating the gypsum resources of Nova Scotia and New Brunswick; including the deposits of the Magdalen islands, in the Gulf of St. Lawrence.

The United States being a large producer of both the crude and the manufactured article, it was deemed advisable that I should visit the industrial centres of this business in that country with a view to obtaining information relative to the modern methods of manufacturing, together with the uses and cost of manufacturing the same. This trip was undertaken in the early part of the year and was highly productive.

The greater amount of gypsum produced in the United States, together with the crude rock imported (principally from Canada), is manufactured by grinding and partial or complete calcination into various plasters, such as plaster of Paris, stucco, cement plaster, flooring plaster, hard finish plaster, etc. The extra refined grades of plaster are used in dental work (11,648 tons were used in the United States for this work alone in 1907). It is also used as a cement for plate glass grinding. A steadily increasing demand exists for this material as a retarder in Portland cement. Considerable quantities are ground and used without calcining as land plaster or fertilizer, while smaller quantities are used in the manufacture of paint and paper, imitation meerschaum and ivory, and as an adulterant. The pure white massive variety, known as alabaster, is much used by sculptors for interior ornamentation. The crude rock is also cut or carved, dehydrated, hardened, and polished for various ornamental uses, in place of marble, and is known as ariston.

Field work for the season began early in June, and continued, weather permitting, throughout the whole season. Over 100 deposits of commercial value have been examined and sampled for analysis.

The gypsum deposits examined occur, without exception, at the summit of the lower Carboniferous series. In this respect they resemble the deposits of the United States, occurring in the lower peninsula of Michigan, in Montana, and in Virginia.

In many instances very little evidence of disturbance is shown, the beds lying quite horizontal or having quite a low angle of dip. There are, however, at some points, especially in the island of Cape Breton, evidences of disturbance of considerable importance, where the beds are crumpled, folded, or tilted to extreme angles.

Many of these deposits follow immediately upon the deposits of carbonate of lime. In some cases the carbonate is so closely associated with the sulphate that it is difficult to draw any line of demarcation; one graduating with diminishing or increasing prominence into the other. At Broad cove, Inverness county, N.S., bunches or patches of pure carbonate of lime may be seen encased in gypsum. At Tom river, Richmond county, N.S., a vein of carbonate of lime about 2 feet wide may be seen in an exposure of gypsum, having a height of from 20 to 30 feet, and cutting it transversely with very distinct walls. The following analysis shows the quality of this vein:—

	Per cent.
Lime	53·13
Ferric oxide and alumina	0·50
Sulphuric anhydride	1·36
Carbonic anhydride	40·99
Water, loss on ignition	1·02
Insoluble mineral matter	3·69
	100·69

While samples from the wall rock give the following results by analysis:—

	Per cent.
Lime	33·20
Ferric oxide and alumina	..
Sulphuric anhydride	46·28
Carbonic anhydride	..
Water, loss on ignition	20·69
Insoluble mineral matter	0·16
	100·65

These deposits present much variety of colour and texture. The greater part of the rock may, in texture, be classed as compact or cryptocrystalline, with lesser quantities as granular or saccharoidal; but in some places considerable quantities of selenite and the fibrous variety occur. Crystals of selenite are often found disseminated irregularly through other varieties; usually in groups or bunches, sometimes in veins.

Anhydrite also occurs in extremely variable proportions in many of the deposits. The irregularity of the occurrence of this mineral—which is practically valueless—with the gypsum, often interferes materially with the economic operation of the quarries.

The following brief description will serve to show the importance of many of the deposits.[1]

No. 1.—East bay, Cape Breton county, N.S.—

Situated about two and a half miles from deep water shipping at the head of East bay, on the Bras d'Or lakes, there is a total gypsiferous area of 2·40 square miles, showing exposures from 20 to 60 feet in height, covering an area of several acres. The greater quantity is a very pure, compact, soft, white variety, with lesser quantities of soft, white granular.

The following analyses show the results of average samples taken from this deposit:—

	I	II
	Per cent.	Per cent.
Lime	32·87	33·10
Sulphuric anhydride	46·07	45·95
Water, loss on ignition	20·89	20·85
Insoluble mineral matter	0·12	0·07
	99·95	99·97

No. 2.—North side East bay, Cape Breton county, N.S.—

On or near the shore at this point occur a number of small deposits of more or less importance. They comprise a total gypsiferous area of 281·6 acres. The greater part of this area is covered with a heavy overburden of clay, and the exposures are small and irregular.

[1] Analyses by Mr. F. G. Wait, Chief Chemist, Mines Branch.

The rock is principally a compact variety of various colours: white, dark grey, grey, blue, black, and pink.

Analysis of the dark variety shows the following results:—

	Per cent.
Lime	31·62
Sulphuric anhydride	42·96
Water, loss on ignition	20·44
Ferric oxide	0·95
Insoluble mineral matter	3·60
	99·57

No. 3.—Tom river, Richmond county, N.S.—

On the southeast side of Great Bras d'Or lake, in a gypsiferous area of 2·7 square miles—comprising Campbell cove, Hay cove, and McNab creek—occur several outcrops of gypsum. Some of these outcrops consist of a very excellent, snowy white, compact variety, resembling alabaster; while others, especially at Tom river, show an excess of lime. The whole is reasonably accessible to water shipment.

The following analyses show the average quality of the rock:—

	I	II	III
	Per cent.	Per cent.	Per cent
Lime	32·95	34·04	33·02
Sulphuric anhydride	46·64	44·28	46·68
Water, loss on ignition	20·93	21·07	20·91
Insoluble mineral matter	0·13	0·67	0·26
	100·65	100·06	100·87

No. 4.—Madame island, Richmond county, N.S.:—

On the north side of Madame island, and the south side of Lennox passage there occurs a large gypsiferous area comprising 3·77 square miles. The outcrops of gypsum in this area having most prominence are situated about one and a half miles west of Lennox Ferry Landing, and about one mile from the shore. At this point the exposures are several acres in area, and have a height of from 30 to 70 feet. Here, years ago, H. C. Higginson, of Newburgh, New York, operated a quarry and exported large quantities of the crude material to the United States. The gypsum is a white, compact variety; but it has irregularly associated with it much anhydrite. The occurrence of this mineral had, no doubt, much to do with closing the quarry. There still remain large quantities of good gypsum, and this, together with excellent, natural shipping facilities, and an increasing demand, should be an inducement to re-open and operate this extensive area.

Analysis:—

	Per cent.
Lime	33·33
Sulphuric anhydride	45·32
Water, loss on ignition	20·92
Insoluble mineral matter	0·22
	99·79

No. 5.—Malagawatchkt, Inverness county, N.S.—

On the south side of Denys basin is a narrow gypsiferous area, skirting the shores from McKenzie brook on the northwest to about half a mile southwest of Matheson's wharf, and continuing southwest by numerous small islands and penin-

sulas to West bay. In this area numerous outcrops of gypsum are seen: at Plaster island; on the River Denys road; George island; Green island, and Floda island.

Many of these outcrops are of little importance, being low, and having but small quantities above sea-level. Several, however, have sufficient prominence to be considered as available supplies. The exposure on Donald McKinnon's farm, River Denys road, has a height averaging 50 feet, with a length of 275 feet. This deposit and its extension two and a half miles northwest to Plaster island, shows probably the most important deposit in the whole area. At Plaster island the exposure is from 10 to 40 feet in height on the shore, and covers an area of four or five acres.

In texture and colour this rock is a soft, white, compact variety, having some anhydrite associated with it.

The following analyses are the results of average samples: No. 1 from the McKinnon outcrop, and No. 2, from the Plaster Island outcrop.

	I	II
	Per cent.	Per cent.
Lime	33·33	33·70
Sulphuric anhydride	45·00	45·25
Water, loss on ignition	20·75	20·78
Insoluble mineral matter	0·33	0·40
	99·41	99·77

No. 6. South side of Whycocomagh, Inverness county, N.S.—

Bounded on the northwest by St. Patrick channel, and on the southeast by Denys basin, is situated a gypsiferous area of 6·78 square miles.

The surface indicates that the greater part of this is underlain by gypsum, and covered by an overburden of clay, varying in thickness. Several exposures are seen in this area, the greater part of which is a white compact variety with lesser quantities of granulated white and grey, with some crystals of selenite. Very little anhydrite is shown.

Analyses of an average sample show—

	Granulated.	Compact.
	Per cent.	Per cent.
Lime	33·33	33·73
Sulphuric anhydride	45·72	46·20
Water, loss on ignition	20·85	20·85
Insoluble mineral water	0·19	0·06
	100·09	100·84

No. 7.—Washabuck peninsula, Victoria county, N.S.:—

This area includes the deposits at McKinnon harbour, Ottawa brook, Washabuck river, Nineveh, Little Narrows, Maciver point, Deadman point, McKay point, Boulaceet harbour, Lieutenant pond, Iona, Jamesville, and Red point. Total area 25·54 square miles. Here all varieties of texture and colour may be found. The exposures are many and large. Anhydrite occurs frequently, outcropping in large irregular masses. This is especially true at Nineveh and at Washabuck; the former having a perpendicular face of 60 to 80 feet, and a length of over 800 feet. At the latter place it shows, on a road leading from Washabuck river to Little Narrows, for nearly a mile in width.

At Ottawa brook, the Newark Lime and Cement Company of Newark, New Jersey, U.S.A., started operations in 1908. They have opened up several deposits and built a railway connecting them with their shipping pier, constructed on the north side of Great Bras D'Or lake.

The rock at some places, where opened up, although a soft, white, compact variety, shows much disturbance, being badly fractured and folded. A dark carbonate of lime is also seen in close conjunction with the gypsum. The composition of these rocks is shown in the following analyses: Sample No. 1, Gypsum; Sample No. 2, Limestone:—

	I	II
	Per cent.	Per cent.
Lime	33·50	51·27
Magnesia	..	0·46
Ferric oxide	..	0·30
Sulphuric anhydride	45·32	0·04
Carbonic anhydride	..	40·72
Water, loss on ignition	21·15	0·86
Insoluble mineral matter	0·10	6·34
	100·07	100·00

At McKinnon harbour the measures are nearly all concealed. About one and a half miles east of the harbour there is an exposure showing a face of good white compact rock, about 30 feet in height. The samples from this show the following composition:—

	Per cent.
Lime	33·13
Sulphuric anhydride	46·04
Water, loss on ignition	20·70
Insoluble mineral matter	0·36
	100·23

On the south side of Red point, and between McKinnon point and Oyster pond, occurs in the bluff of the shore a mixture of gypsum and limestone, associated with selenite, having large transparent plates or crystals, covered with a very plastic, smooth, red clay. The colour of the rock varies from a dark grey, and mottled, to a pure white, having a compact texture.

The clay carries particles of gypsum, and might be classed as gypsite. The following are the results of analyses of samples taken from this deposit:—

	I	II	III	IV
	Per cent.	Per cent.	Per cent.	Per cent.
Lime	51·88	38·20	33·67	33·67
Ferric oxide and alumina	0·43	trace	trace	..
Sulphuric anhydride	0·96	42·16	44·77	45·44
Carbonic anhydride	40·76	2·49	..	..
Water, loss on ignition	0·57	20·83	20·80	20·92
Insoluble mineral matter	5·40	1·60	0·40	0 07
	100·00	100·28	99·64	100·10

No. I.—Dark grey, with particles of selenite.
II.—Grey mottled.
III.—Pure white.
IV.—Selenite.

At Little Narrows (south side) on the properties of M. J. McAskill, and widow McAskill, very large exposures are seen. At the latter the face is about 100 feet high,

and over 600 feet long. The rock is an excellent quality of soft, white, compact variety, with but few irregularities. It is situated about one mile from the shipping point on St. Patrick channel.

The composition is shown by the following analysis:—

	Per cent.	Per cent.
Lime	33·30	33·67
Sulphuric anhydride	46·00	46·00
Water, loss on ignition	21·16	20·70
Insoluble mineral matter	0·24	0·20

On the north side, Little Narrows, the measures are concealed by an overburden of clay.

From Maciver point to Deadman point the deposits are not considered—at present—to be of any commercial value. This is also true of the greater part of the Washabuck river. East of Boulaceet harbour, although no exposures are seen, yet the indications on the surface are rather encouraging, and further investigation may develop a property of considerable commercial value.

At Lieutenant pond, and at Iona, exposures are seen near the sea-shore of sufficient area to make them of considerable value.

The greater part of the rock is a soft, white, compact variety, with smaller quantities of granular texture; also some grey and blue rocks are perceptible. Anhydrite also occurs with some prominence. The following analyses show the results of samples from this rock.

	I	II
	Per cent.	Per cent.
Lime	33·20	40·16
Sulphuric anhydride	45·60	55·60
Water, loss on ignition	21·06	4·52
Insoluble mineral matter	0·15	0·13
	100·01	100·41

No. 8.—Nyanza, Victoria county, N.S.:—

This section, together with Middle river and Baddeck river, comprises a total gypsiferous area of 14·60 square miles. With the exception of three points, the whole is devoid of outcrops, and has an overburden of clay of varying thickness. They all have an outport at Indian bay—a tributary of St. Patrick channel.

At the rear of Alex. McGregor's house a small, white, granular rock is outcropping, having a face from 10 to 20 feet, with an elevation of 60 feet above sea-level.

On James McGregor's farm, near the Baddeck river, another outcrop of a few acres occurs; but so near the sea-level that little commercial value can be attached to it, beyond its use for local purposes.

Analyses of this rock show the following composition:—

	I	II
	Per cent.	Per cent.
Lime	32·99	33·17
Sulphuric anhydride	46·60	46·28
Water, loss on ignition	20·88	20·96
Insoluble mineral matter	....	....
	100·47	100·41

No. 9.—Port Bevis or Big harbour, Victoria county, N.S.:—

From Baddeck bay on the west to St. Ann bay on the east may be considered as one continuous gypsiferous bed having an area of 15·83 square miles.

It contains many important outcrops of gypsum and anhydrite, but the latter in greater prominence.

On the shores of the Great Bras d'Or, west of Port Bevis, cliffs or solid walls of anhydrite, 10 to 50 feet in height and nearly one mile long, may be seen at different points. These are often capped with from a few inches to a few feet of gypsum, due, without doubt, to the absorption of moisture from the atmosphere.

The most important gypsum outcrops found in this area are at the head of Baddeck bay—about one mile from deep water shipping; at the rear of Margaret McKenzie's grant—about one mile from McDonald point; on the farm of Alex. McKenzie (near his house) at Plaster mines; three miles from South Gut and at North Gut. Some of these show a little anhydrite, but gypsum of a good, white, compact variety has prominence. The softer variety apparently occurs farther inland than the harder quality, and may be due to disturbance and metamorphic action.

At Port Bevis, a few years ago the Victoria Gypsum Company carried on extensive operations, but owing to increasing occurrence of anhydrite, at depth, the place was abandoned.

The following analyses will show the composition as a fair average from this section:—

	I	II	III	IV
	Per cent.	Per cent.	Per cent.	Per cent.
Lime	32·80	33·77	38·10	33·60
Sulphuric anhydride	46·08	44·63	53·16	45·45
Water, loss on ignition	21·07	21·05	8·72	20·70
Insoluble mineral matter	0·18	0·27	0·26	0·20
	100·13	99·72	100·24	99·95

No. I.—Sample from rear of Alex. McKenzie's house.

No. II.—Sample from the Margaret McKenzie grant.

No. III.—Sample from a face 70 feet high and 650 feet long east of Alex. McKenzie's house.

No. IV.—Sample from near South Gut.

No. 10.—Boularderie island, Victoria county, N.S.:—

On the south side of Boularderie island there is a small area of 282 acres, known as Island point. It is about two miles long, projecting into St. Andrew channel, and is practically made up of gypsum outcrops, with some small patches of carbonate of lime.

The rock in the most part is white in colour, some little grey intermixed; all a compact soft variety.

The following analyses show the comparison:—

	I	II
	Per cent.	Per cent
Lime	32·24	33·33
Sulphuric anhydride	46·08	45·93
Water, loss on ignition	20·85	20·82
Insoluble mineral matter	0·50	....
	99·07	100·08

No. 11.—Goose cove, St. Ann bay, Victoria county, N.S.:—

Here, and at Oregon, four and a half miles from the mouth of North river, occur small gypsiferous areas: at Oregon, 134 acres; at Goose cove, two areas having a total area of 230 acres. At the former place the measures are all concealed; at the latter large exposures from 40 to 60 feet in height are seen. One of these has been opened up and operated for several years by the Victoria Gypsum Company. It is situated three and a half miles by rail from their shipping pier at Munroe point. The rock is white, light grey, and mottled white in colour; the white having prominence. The outcrops are a soft, compact variety, and the operations here prove this to be true to a depth of 30 or 40 feet; but during the summer of 1908, while sinking on the floor of the quarry, anhydrite was discovered in considerable quantities. The following analyses show the composition:—

	I	II	III
	Per cent.	Per cent	Per cent.
Lime	42·80	33·20	32·87
Ferric oxide and alumina	trace.	....	....
Sulphuric anhydride	56·16	46·08	46·14
Water, loss on ignition	0·73	20·68	20·73
Insoluble mineral matter	0·80	0·30	0·20

No. I.—Sample from floor of quarry.
No. II.—Sample of mottled white.
No. III.—Average sample from stock pile.

No. 12. Ingonish, Victoria county, N.S.

On the north side of Ingonish harbour white cliffs of gypsum are seen, having an average height of 50 feet. The outcrops and gypsiferous measures have a total area of 287 acres, and extend northeasterly through the Donovan and Shea grants, to the northeast shore of South bay, where small outcrops are again seen. The rock is a very pure, compact, white variety.

Analysis:—

	Per cent.
Lime	33·12
Sulphuric anhydride	45·88
Water, loss on ignition	21·10
Insoluble mineral matter	0·22
	100·32

No. 13. Aspy bay, Victoria county, N.S.

Here, extending from the Atlantic ocean inland about six miles, in a somewhat triangular shape, is a gypsiferous area of 7·98 square miles. Although much of this area is low interval land, yet there are many large exposures of gypsum. This is particularly true on the north side of Middle pond and on Middle river, where exposures from a minimum to 70 feet in height are seen covering many acres.

At present these deposits are inaccessible for want of shipping facilities. The natural outport would be North pond at Dingwall. This has been a good harbour with abundance of water, but has been closed to navigation by the sea washing up sand and gravel from the ocean, and forming a bar across the entrance.

The rock is white, mottled white, and grey, and of compact crystallization. Some little anhydrite is seen on Middle river, and in this, cells of crude petroleum are found. The following analyses are from average samples taken from this section, and will serve to show the composition:—

	Per cent.	Per cent.	Per cent.
Lime	41·30	33·62	32·97
Sulphuric anhydride	57·81	45·28	46·16
Water, loss on ignition	0·82	21·06	21·00
Insoluble mineral matter	0·07	0·05	0·15
Bitume	0·08	....	-
	100·03	100·01	100·28

No. 14. Bay St. Lawrence, Victoria county, N.S.

In the most northerly bay of the island of Cape Breton there occurs a small gypsiferous area with few outcrops. It is practically inaccessible as a commercial product, and could be utilized only for local purposes.

No. 15.—The above applies and is also true of a small area at Pleasant bay, Inverness county, N.S.

No. 16.—Cheticamp, Inverness county, N.S.:—

The Cheticamp gypsiferous area of 2·76 square miles is one of the most available and important deposits of the Province. It extends south from the mouth of the Cheticamp river on the north to below Friar point. The principal outcrops are in the valley of Au Coin brook and at Grand Etang, occurring in cliffs from 60 to 120 feet in height. Much of the area, however, is covered with an overburden of clay, in many places not exceeding 2 feet in thickness.

The Great Northern Mining Company has developed quarries on the Au Coin outcrops, and erected a very modern, electrically driven, plaster mill, on the interval below, one and three-quarter miles southeast of Eastern harbour, where ample shipping facilities have been acquired.

The gypsum, as developed, is made up of different beds, and has a total thickness of over 1,000 feet. The first, or lower bed, consists principally of a rock, white in colour, containing very small crystals of selenite. This is succeeded by a very heavy bed of snowy white, compact gypsum, mottled and banded with a dark bituminous material. The next in order is a thick bed of hydraulic limestone. Above this is a vast bed of selenitic grey and white gypsum, cut by vertical veins of pure transparent selenite running parallel to the strike, with veinlets or stringers cutting off horizontally. One vein of selenite has a width of from 8 to 20 feet, and may be traced for at least half a mile.

The following analyses will show the quality of a portion of this deposit. Other analyses follow showing the results of careful sampling of the whole deposit:—

	I	II
	Per cent.	Per cent.
Lime	32·96	32·80
Sulphuric anhydride	46·20	46·32
Water, loss on ignition	0·98	20·92

No. I.—General sample across face of white quarry.
" II.—From the 8 ft. selenite vein.

No. 17.—Margaree river, Inverness county, N.S.:—

In the valley of the Margaree river occur several gypsiferous areas which will be known as: Margaree, 1·41 square miles; northeast Margaree, 8·60 square miles; southwest Margaree, 3·55 square miles; and the Ross section, 1·6 square miles.

In the Margaree area all the gypsum is concealed with an overburden of clay, except a small outcrop on the shore near the mouth of the river. The above is also true of southwest Margaree; small outcrops occurring on Allen brook, and at Upper Margaree.

In the northeast Margaree area, outcrops occur at Levis farm, Hogsback hill, and on the west side of the river. The most important of these is that at Hogsback hill, where good, white, compact gypsum outcrops in considerable prominence.

In the Ross section, the principal outcrop occurs on the west side of northeast Margaree river, near where Munro brook disappears in the Gypsum cave.

Although much of this is a very good quality, yet it is not at all probable it will ever become of great commercial value; being inaccessible to transportation facilities. It should have some value for local purposes, such as a fertilizer, as the soil of the Margaree valley is particularly adapted for its use, and would give excellent results on clover and leguminous crops.

The following are analyses taken from this territory:—

	I	II
	Per cent.	Per cent.
Lime	33·20	33.00
Sulphuric anhydride	44·68	45·64
Water, loss on ignition	21·04	20·96
Insoluble mineral matter	0·30	0·30
	99·22	99·90

	III	IV	V.
	Per cent.	Per cent.	Per cent.
Lime	30·80	32·80	33·20
Ferric oxide and alumina	0·60	0·30	....
Sulphuric anhydride	40·80	45·72	46·32
Carbonic anhydride	1·85	....	....
Water, loss on ignition	19·80	20·62	20·92
Insoluble mineral matter	5·64	0·80	....
	99·49	100·24	100·44

No. 18.—Broad Cove marsh, Inverness county, N.S.:—

In this section occur three small gypsiferous areas. The most prominent is on the sea-shore, about a quarter of a mile north of the mouth of McLeod brook; and although narrow, it extends northwardly nearly two miles. This, together with the other two lying between the road leading to southwest Margaree and the road to Inverness, make up a total area of 214 acres. They are, at present, unimportant from a commercial standpoint, being inaccessible to shipping facilities.

No. 19.—Inverness, Inverness county, N.S.:—

Here, having the advantage of the Inverness and Richmond railway and its probable extension, the deposits again become more important. At Broad Cove chapel—outcropping at the sea-shore—are extensive cliffs, consisting largely of a white, compact variety, with some little grey associated, and limestone encased in gypsum, as described on page 89. This deposit has an area of 84 acres.

In the rear of the Broad Cove Chapel area, about three-quarters of a mile back from the shore, and extending inland nearly to Loch Ban, is another area of 420 acres. This has practically no outcrops, being covered almost entirely with a heavy overburden of clay.

Two and a half miles from Inverness town, the third area in the section occurs, containing 614 acres. In this, some very prominent outcrops can be seen. Just below the big trestle, at a point known as the Laurie quarry, the outcrop has a height of 45 feet above drainage level. The rock is a white, compact variety, mixed with a dark grey, shaly variety, having rusty stains. Above this, about one mile on the McIsaac lot, an outcrop shows more even texture and colour, being principally white and compact.

The following are analyses of samples from this section:—

	I	II	III	IV
	Per cent.	Per cent.	Per cent.	Per cent.
Lime	32·80	33·00	34·20	33·00
Ferric oxide and alumina	....	....	0·20	....
Sulphuric anhydride	46·20	46·56	46·05	46·60
Water, loss on ignition	20·92	20·90	20·60	20·69
Insoluble mineral matter	....	....	....	0·90
	99·92	100·46	99·90	100·29

No. I.—Sample from Broad Cove chapel.
" II.—White, compact, from Laurie quarry.
" III.—Dark grey, shaly, from Laurie quarry.
" IV.—White, compact, McIsaac lot.

No. 20.—Mabou, Inverness county, N.S.:—

In this section there are numerous gypsiferous areas, which are more or less available for commercial purposes. They comprise a total area of 6·55 square miles.

At Finlay point, on the sea coast, and about one mile north of Mabou coal mines, occur cliffs of excellent, white, compact gypsum, from 35 to 50 feet in height. This area extends along and borders the sea coast for nearly three and a half miles. The exposures here are large, and every indication points to a large deposit of gypsum of a quality suitable for all ordinary manufacturing purposes; but the sea coast is rugged and very little protection could be given to shipping. To operate this deposit it would, therefore, be necessary to make the shipping point at Mabou harbour, a distance of three and a half miles, over a rather difficult pass.

At Mabou harbour the most important deposits are located, known as the Colonel Snow property, and the Beaton property.

The rock here is exposed in cliffs from 45 to 60 feet high, and consists almost wholly of a white, compact gypsum, with smaller quantities showing microscopic crystals of selenite. Very small quantities of anhydrite may be seen at the base of the cliffs.

Following east to Hillsborough and south to southwest Mabou large gypsiferous areas occur, but consist in the greater part of concealed measures. Large outcrops occur at Hillsborough, of a very soft, grey and dark grey, granular gypsum suitable only for land plaster. At southwest Mabou the rock is similar in texture, and has associated with it fine crystals of selenite.

The following analyses of samples from these different deposits will show the composition:—

	I	II	III
	Per cent.	Per cent.	Per cent.
Lime	32·80	32·80	33·88
Sulphuric anhydride	45·90	46·20	44·36
Water, loss on ignition	20·85	20·85	20·87
Insoluble mineral matter	0·40	0·30	0·50
	99·95	100·15	99·61

	IV	V	VI
	Per cent.	Per cent.	Per cent.
Lime	32·92	33·40	33·00
Sulphuric anyhydride	46·24	46·28	45·61
Water, loss on ignition	20·87	20·45	21·20
Magnesia	..	trace	..
	100·03	100·13	99·81

No. I.—Sample from Hillsborough—Light grey with heavy red incrustation.
" II.— " Hillsborough—Dark grey, soft, granular.
" III.— " Beaton property—White, compact, variety.
" IV.— " Col. Snow property—White, compact, with crystals of selenite.
" V.— " Finlay point—White, compact and free from selenite.
" VI.— " Southwest Mabou—Very soft, granular, with selenite crystals.

No. 21.—Smith island and Big Bridge, Inverness county, N.S.:—

Following south from Mabou to Port Hood, and continuing south to Glencoe, many gypsiferous areas will be found. From surface indications they would not be classed at the present time as commercially important, having small individual areas of little prominence, and generally carrying a heavy burden of clay.

The total area of this group is 369 acres, and the most important of the whole is that known as Smith island, consisting of 149 acres.

This island is situated about one mile from the mainland and opposite Port Hood. Its topography is low and the exposures, which in greater part are on the exposed side of the island, are few.

No. 22.—Askilton, Inverness county, N.S.:—

In this section we have what may be known as the Hastings area of seventy-five acres at Port Hastings; the Beaver Dam Lake area of 1·6 square miles, on the border line of Inverness and Richmond counties and about four and a half miles east of Point Tupper; the Askilton area of 1·8 square miles at Askilton, three and a half miles from the Intercolonial railway, or about six miles east of Port Hastings; also a small area about one and a half miles south of Askilton on Inhabitants river, consisting of 302 acres.

The Inhabitants River area, and the Beaver Dam Lake area, have very little prominence, being situated in the low ground; the Beaver Dam lake being only traceable by the pits or kettle holes, and hummocky ground. In the banks of Inhabitants river small outcrops are seen, but both areas seem to be covered heavily with clay.

The Hastings area is small. The greater part of it seems to have been eroded by the sea, and now forms a small inlet or cove having a floor of gypsum. The greater part of what remains is in outcrops from 30 to 60 feet high, consisting of a variety of colours and texture, with considerable anhydrite.

The Askilton area is the most important from all points of view in this section. It has large outcrops, some as high as 70 feet above drainage level, and the greater part is an excellent, white, compact variety, with smaller quantities of granular.

The Strait of Canso—the natural outport for the deposit, being an open port all the year—makes this deposit desirable: especially to those who export large quantities of crude rock, since it is the nearest deposit to a winter port in the Province.

The following analyses from samples of the different deposits obtainable will serve to show the average composition of these deposits:—

	I	II	III
	Per cent.	Per cent.	Per cent.
Lime	40·48	33·80	33·20
Sulphuric anhydride	55·48	46·08	46·32
Water, loss on ignition	3·90	19·86	20·85
Insoluble mineral matter	0·44	....	0·14
	100·30	99·74	100·51

	IV	V
	Per cent.	Per cent.
Lime	34·20	33·20
Sulphuric anhydride	45·92	45·84
Water, loss on ignition	20·65	20·60
Insoluble mineral matter	....	0·90
	100·77	100·54

Nos. I and II.—Average samples, Hastings area.
" III and IV.—Average samples of the white compact, Askilton.
" V.—Sample of the granular Askilton area.

No. 23.—River Denys, Inverness county, N.S.:—

Practically joining the McKinnon Harbour area on the east, and the Malagawachkt on the south, is a section known as River Denys. This includes a total gypsiferous area of 5·06 square miles. The principal part of this is traceable only by surface indications. The most prominent outcrop is on the east side of River Denys, below Munroes Bridge. There, the outcrops rise above the sea-level, from 10 to 45 feet, and consist principally of grey and light grey, white and mottled white; much of it having a compact texture with large portions of granular. Dark grey carbonate of lime is also found associated.

The composition of this outcrop is seen in the following analysis:—

	Per cent.
Lime	33·17
Sulphuric anhydride	45·43
Water, loss on ignition	20·63
Insoluble mineral matter	0·93
	100·15

No. 24.—Black river, Richmond county, N.S.:—

At Black river, south side of West bay, occurs a gypsiferous area of 1·81 square miles. This is reasonably accessible to water transportation, and may be considered as a property having commercial value. The outcrops are principally on the banks of the river, about one mile and two and a half miles from its mouth. The greater part of the rock is a white, compact variety. Some small quantities are coloured with oxide of iron. The analyses of this deposit are not yet available.

No. 25.—Saunders cove, Cape Breton county, N.S.:—

On the south side of Boularderie and west of Grove point occurs a small gypsiferous area of 299 acres. The outcrops on the shore are small, and the area is traceable only by surface indications. The quality is a white, compact variety, associated with considerable quantities of carbonate of lime.

The following short description will indicate the location of the deposits examined and sampled throughout Nova Scotia, exclusive of those above described, from the island of Cape Breton.

COLCHESTER COUNTY, N.S.

No. 1. Deposits crossing the farms of Gregory Yuill, Samuel Creelman, and Constantine Wheelock on Pitch brook, near the mouth and on the north side of the Shubenacadie river. Three outcrops are first observed, about one mile back from the river, in the valley and banks of the brook.

Analyses:—

	I	II	III	IV
	Per cent.	Per cent.	Per cent.	Per cent.
Lime	30·80	32·88	32·20	33·80
Sulphuric anhydride	45·72	44·92	44·64	44·92
Water, loss on ignition	20·60	20·47	20·44	20·54
Insoluble mineral matter	1·30	1·70	2·30	0·80
	100·42	99·97	99·58	100·06

No. I.—Gregory Yuill—grey fibrous.
" II.—Gregory Yuill—grey massive.
" III.—Constantine Wheelock—dark grey with radiating structure.
" IV.—Samuel Creelman—light grey, massive.

No. 2. The deposit on the farm of G. W. Dart, at Green Oak, about one mile below the Midland Railway (D.A.R.) bridge.

The outcrop occurs in the bank of the Shubenacadie river, and is a dirty, dark, greyish, granular variety, suitable only for land plaster.

Analyses:—

	I	II	III
	Per cent.	Per cent.	Per cent.
Lime	33·20	33·20	4·40
Ferric oxide and alumina	....	0·40	2·50
Sulphuric anhydride	47·04	45·28	4·24
Water, loss on ignition	19·22	20·66	5·01
Insoluble mineral matter	0·30	0·80	79·52
	99·76	100·34	95·67

No. I.—General samples of the rock.
" II.—Sample with dark bark-like encrustations.
" III.—Clay mixed with the gypsum.

Also at Green Oak, on the farm of Thomas Phillips, occurs a large outcropping of excellent, white, granulated and white, compact gypsum. This deposit can be considered commercially valuable, and years ago was operated on that basis.

Analyses:—

	Per cent.	Per cent.
Lime	32·80	32·92
Ferric oxide and alumina	....	0·40
Sulphuric anhydride	46·16	45·16
Water, loss on ignition	20·94	21·00
	99·90	99·48

No. I.—Pure white, granulated.
No. II.—Pure white, compact.

No. 3.—At Hilden, about two miles south of the Intercolonial railway, on the James Morgan estate, occur outcrops of blue, grey, and white gypsum, in exposures having an extreme height of 55 feet.

The greater part of this rock has a compact texture, but some granulated and selenitic forms are seen.

Analyses:—

	I	II
	Per cent.	Per cent.
Lime	33·08	33·00
Sulphuric anhydride	45·92	46·08
Water, loss on ignition	21·20	20·90
Insoluble mineral matter	0·10	0·10
	100·30	100·08

No. 4.—On the farm of John Irwin and the adjoining properties, situated at Irwin lake, three and a half miles east from the tidal waters of Cobequid bay, occur outcrops of gypsum of more or less prominence. The greater part of this gypsiferous area consists of concealed measures. The outcrops are in the most part a white granular variety.

Analyses:—

	I	II
	Per cent.	Per cent.
Lime	32·60	34·00
Ferric oxide and alumina	0·20	1·08
Sulphuric anhydride	45·88	45·72
Water, loss on ignition	21·00	17·77
Insoluble mineral matter	0·50	0·40
	100·18	99·97

No. I.—White granular.
" II.—White streaked with red and showing excess of carbonate of lime.

No. 5. About one mile nearer the tide waters of Cobequid bay, on Beaver brook, occur numerous outcrops of white, compact gypsum; but in the greater number of exposures anhydrite is found closely associated. On the farm of Isaac Sanderson this is particularly well demonstrated.

Analyses:—

	I	II	III
	Per cent.	Per cent.	Per cent.
Lime	36·80	33·20	33·72
Ferric oxide and alumina	0·40	....	....
Sulphuric anhydride	51·44	46·40	46·00
Water, loss on ignition	11·73	20·79	20·94
Insoluble mineral matter	....	....	0·35
	99·87	100·39	100·01

No. I.—The interior of a boulder of anhydrite which has been exposed for about 25 years.
" II.—An outside coating about 4" thick taken from No. 1.
" III.—White compact variety occurring in same deposit.

No. 6. In Pleasant Valley, two miles south of Brookfield station on the Intercolonial railway, and five miles north of the Shubenacadie river, occur outcrops of dark, grey gypsum, showing the following analyses from average samples:—

	Per cent.
Lime	33·00
Sulphuric anhydride	45·76
Water, loss on ignition	20·78
Insoluble mineral matter	0·90
	100·44

No. 7. From two to five miles north of Brookfield station, on the Intercolonial railway, occurs a large gypsiferous area, having numerous outcrops. The principal outcrops are to be seen on the banks of the Little river running through the farms of Leonard Carter, James Lockhart, John McCulloch, J. J. Snook, Alonzo Lockhart, and on the property of Robert E. Benjamin.

Analyses:—

	I	II	III	IV
	Per cent.	Per cent.	Per cent.	Per cent.
Lime	38·20	39·88	33·00	33·00
Manganese	1·06	..	..	..
Sulphuric anhydride	53·80	51·28	46·20	45·72
Carbonic anhydride	1·17	1·81	..	..
Water, loss on ignition	5·16	7·16	20·85	20·92
Insoluble mineral matter	0·10	..	..	..
	99·49	100·13	100·05	99·64

	V	VI	VII	VIII
	Per cent.	Per cent.	Per cent.	Per cent.
Lime	33·80	31·28	31·60	32·88
Ferric oxide and alumina	0·56	1·80	1·00	..
Sulphuric anhydride	42·04	42·44	42·64	45·52
Carbonic anhydride	3·44	trace	..	..
Water, loss on ignition	19·32	19·63	20·29	20·82
Insoluble mineral matter	0·80	4·20	4·00	0·46
	99·96	99·35	99·53	99·62

No. I.—Leonard Carter—anhydrite occurring in close contact with carbonate of lime.
" II.—Leonard Carter—a mixture of light grey and white.
" III.—James Lockhart—white, compact.
" IV.—John McCulloch—white, compact.
" V.—Robt. E. Benjamin—white and greyish white.
" VI.—J. J. Snook—a red pinkish mixture associated with marl.
" VII.—Robt. E. Benjamin—black, compact, somewhat columnar in structure.
" VIII.—Alonzo Lockhart—soft, white granular.

No. 8.—At Debert on the Lynds farm occurs a small deposit, unimportant for commercial purposes, but of geological interest, and well adapted to local uses as a fertilizer.

Analyses:—

	I	II
	Per cent.	Per cent.
Lime	32·00	39·20
Manganese	..	0·12
Ferric oxide and alumina	0·48	..
Sulphuric anhydride	41·80	17·24
Carbonic anhydrite	..	21·45
Water, loss on ignition	20·91	(1·99)
Insoluble mineral matter	4·40	20·00
	99·59	100·00

No. I.—A greyish white, showing crystals of selenite.
" II.—Sample of dark siliceous carbonate of lime intermixed throughout the whole mass.

No. 9. East mountain—on the farms of Geo. Thompson, Samuel Roode, and Elisha Archibald, occur small isolated deposits of gypsum.

The Geo. Thompson property—about two and a half miles north of the Intercolonial railway—shows some very excellent white, compact gypsum, but the greater part of the exposure occurs as anhydrite.

Samuel Roode deposit—about two miles west of the above, and one and three-quarter miles from the railway—is a dark grey, granular variety. Operations have been carried on here in a small way and the product prepared and used as fertilizer.

Elisha Archibald deposit—situated about two and a half miles east of Thompson's, and one and a quarter miles north of the railway from Union station. This deposit shows in its outcrops an excellent quality of white, compact gypsum, with no anhydrite exposed.

Analyses:—

	I	II	III	IV
	Per cent.	Per cent.	Per cent.	Per cent.
Lime	33·12	41·20	32·80	33·20
Manganese	..	..	..	0·15
Sulphuric anhydride	46·68	58·36	45·92	45·44
Carbonic anhydride	..	..	..	0·17
Water, loss on ignition	20·68	..	20·04	20·55
Insoluble mineral matter	..	0·28	0·92	..
	100·43	99·84	99·68	99·51

No. I.—Geo. Thompson—associated with large quantities of pure white anhydrite.
" II.—Geo. Thompson—pure white anhydrite, associated with No. I.
" III.—E. Archibald—white compact.
" IV.—Samuel Roode—greyish white.

HANTS COUNTY, N.S.

The following deposits in Hants county have been examined and sampled, but the analyses are not yet available.

The property of the Newport Plaster and Cement Company, consisting of an area of about 4,000 acres. Here, the principal operations are carried on at Avondale, where they have shipping piers on the Avon river.

The Miller Creek property, situated near the Dominion Atlantic railway (Midland branch), and about five miles from Windsor.

The Chambers property at Meander, Brooklyn, and River Hebert.

The Mount Denson property on the southwest side of the Avon river.

The upper and lower Falmouth deposits, opposite Windsor.

The Wentworth Gypsum Company (1,200 acres), at Wentworth and Newport.

The Phillips property, situated east of the Wentworth Company's property and having the St. Croix river as its eastern boundary.

The Windsor gypsum property at Newport.

The Nova Scotia gypsum property at Threemile Plains.

CUMBERLAND COUNTY, N.S.

The Lockhart and King properties, at Hansford.

The deposits on Pugwash river and Philip river.

The Fowler quarry, at Amherst point.

The Newcombe property and the Maritime Gypsum Company's property at Nappan; and the Swan Creek deposit near Parrsboro.

In the Province of New Brunswick the following extensive deposits have been examined and sampled:—

At Hillsborough—the properties of the Albert Manufacturing Company and the J. B. King Company.

The Petitcodiac deposits—the Sussex and Upham deposits, and the deposit at Plaster Rock, on the Tobique river.

On the Magdalen islands, Que.—Deposits on Grindstone, Alright island, and Amherst island.

The analyses of these, with full descriptions of each deposit, and approximate areas and quantities available, together with cost of production and manufacturing, will appear in the final report. This general report will also contain plans and specifications of modern mills for the manufacturing of gypsum products, with tentative costs of construction and operations.

SESSIONAL PAPER No. 26a

ON FURTHER INVESTIGATION OF THE ASBESTOS DEPOSITS IN THE PROVINCE OF QUEBEC.

Fritz Cirkel, M.E.

Having examined all the producing asbestos mines, as well as asbestos occurrences not yet developed in the Eastern Townships of the Province of Quebec; and having also delimited the Broughton serpentine belt as set forth in my preliminary report for 1908, I devoted my time during the winter season 1908-9 to writing my report thereon and to plotting the survey over the Broughton serpentine range, which has now become a factor in the production of asbestos in that region. However, it was found that while the field work was in progress, additional important discoveries had been made in the direction of the serpentine belt in the township of Thetford; and for this reason it was deemed advisable to continue the field work during the summer season of 1909, with a view to determining the exact position of the continuation of that serpentine range in the township of Thetford, and its connexion with the extensive productive belt of Thetford-Black lake. Consequent upon a little flurry and excitement in the region, caused through the formation of additional asbestos companies—a thing of rare occurrence up to that time in the region—the prospector showed great activity, and while a great number of so-called discoveries were made, it was found that after thorough investigation these alleged new asbestos locations were in the majority of cases nothing else than huge boulders, buried deep in the overburden. All these finds gave rise at the begining to the supposition that the serpentine range, especially in the township of Thetford, was of considerable extent, especially as far as its width is concerned; and the belief was expressed that a great many productive mines might be added in the near future to those already in existence. My investigations, however, point to the fact that, excepting the long established mines in the southwesterly part of the township, this alleged productive serpentine belt is in reality of very limited dimensions, and is to be found only on ranges V and IV of that township. All the discoveries made outside this range amount to nothing. The writer lays special emphasis on this point; because operators and prospectors have spent much time and money in the development of many of these new finds, and not in one case were the deposits of sufficient extent and quality to warrant exploitation.

In addition to the serpentine range in Thetford, the big productive belt in which all the great Thetford and Black Lake mines are located was delimited. This piece of work was far more difficult to accomplish than was at first supposed; due primarily to the inaccessibility of a great part of the country, and also to the heavy humus and forest growth which covers the formation in different parts, which hides from view the different rock formations. This refers specially to the northwesterly boundaries of the range in the townships of Ireland and Wolfestown. In these cases the boundaries were laid down, based on conjectured evidence; but it is believed future exploration work will demonstrate that the contact lines of the formation will be found to be approximately correct.

As to the asbestos industry as a whole, I have dwelt upon its expansion and progress at some length in my preliminary report for 1907-8, and can only add that, the predictions as laid down in that report are, indeed, far surpassed by actual facts.

Since September 1, 1908, not less than five new asbestos mines have been added to the list, on all of which large milling plants are being erected at the present time. The total additional milling capacity of all these new establishments will be twenty-

six cyclones. Figuring on a total tonnage of 120 tons per day per cyclone, and an extraction of 6 per cent of the mill rock, this means an increase in the production of asbestos per day of 189·20 tons of mill fibre.

It is, of course, possible that if all these new mines put their product on the market simultaneously, overproduction will for some time follow; the writer is of opinion, however, that no fear need be entertained regarding the commercial disposal of such a large additional output; for the exigencies and demands of the market have, so far, kept pace with the increasing yearly output, hence it is confidently expected that in view of the ever increasing demand for asbestos slate—which consumes most of the mill fibre—no serious results need be anticipated.

INVESTIGATION OF REPORTED IRON ORE OCCURRENCES IN THE PROVINCES OF ONTARIO, QUEBEC, AND NEW BRUNSWICK.

B. F. Haanel, B.Sc.

I beg to transmit, herewith, a preliminary report of my work during the summer of 1909.

This season I was instructed to examine as many iron ore mines and prospects along, and in the vicinity of the Central Ontario railway, as the time permitted; with a view to examination by means of magnetometric survey of those deposits the importance of which would justify further work. I had received instructions to this effect two years ago, but, owing to work of more immediate importance, it was impossible to begin the examination at that time. This investigation was, therefore, begun by Mr. Fréchette, who examined and made magnetometric surveys of some of the most important iron mines and prospects in the vicinity of Bessemer, Ont.

Owing, however, to some important examinations, which I was instructed to make in other parts of Ontario and Quebec, this work was again delayed to such an extent that it was possible to devote only a short time this season to the work outlined above.

The following occurrences of iron ore were examined during the summer. An occurrence of magnetic iron ore on lot 20, con. XI, and lot 7b, range V, county of Wolfe; and lots 1 and 3, range X, county of Megantic; also occurrences of chrome iron ore, near both these places; and an occurrence of magnetic iron ore near Namegos station, on the Canadian Pacific railway. Two iron properties, namely, the Chaffey and Matthews iron mines, near Newboro on the Rideau lake, were examined, and a preliminary magnetic survey made of the Matthews iron mine. Those examined along the Central Ontario railway were: Coehill iron mine; Jenkins iron mine; and occurrences of iron ore on lot 22, con. IX, township of Wollaston, county of Hastings, all in the vicinity of Coehill village; and an occurrence of iron ore near Gilmour, and two in the vicinity of Bancroft. In addition to the work just enumerated, an investigation of the northeastern corner of Northumberland county was made, where, according to reports, heavy magnetic attractions were observed, which, it was believed, pointed to the existence of an ore body. Observations were also made in the vicinity of Kingston, Ont., where, according to the magnetic survey of Kingston harbour made in the year 1863, we were led to believe iron ore might exist. An examination was also made of an occurrence of iron ore near Gaspereau station, N.B., with a view to locating positions for diamond drilling.

The summer work was somewhat broken by travelling from one region to another, and by the necessity for my presence in Ottawa in connexion with the fuel testing station.

OCCURRENCE OF MAGNETITE AND CHROME IRON ORE IN THE COUNTIES OF WOLFE AND MEGANTIC, QUE.

In view of the construction of the proposed Quebec Eastern railway, the assistance of the Mines Branch was sought for the purpose of examining the ore occurrences along, and in the vicinity of, the projected route of the railway. In accordance with instructions, my work was confined to the examination of occurrences of iron ore in the counties of Wolfe and Megantic.

In the county of Wolfe, on lot 20, con. XI, near the northwestern shore of Lake Nicolet, the existence of a deposit of magnetite of considerable size was reported.

This occurrence was reputed to form part of an iron range extending for over a mile, and hope was entertained that it would prove, upon examination, to be a large deposit.

The ore is a magnetite, high in titanic acid, and carries about two per cent Cr_2O_3, and a trace of copper. Associated with the ore, in places, are calcite, and crystals of ilmenite.

The deposit occurs in serpentine, and consists of two outcrops, lying about 30 feet apart. The combined dimensions of the two outcrops are about 30 feet in length by 15 feet in width. On the largest outcrop a pit was sunk, from which some ore was raised. Some of this ore lies on the surface, adjacent to the pit. At the time of my visit the pit was full of water, which prevented an examination of the walls and bottom.

To determine the extent of this deposit, observations with the magnetometer were made over a considerable area of the surrounding neighbourhood; but the field proved to be normal, except within the immediate vicinity of the outcrop—even here the attraction was very feeble.

The deposit may be described as a pocket of a titaniferous ore, of no economic value.

The following is an analysis of a sample of ore taken from the pit:—

	Per cent.
Metallic iron	46·50
TiO_2	26·50
Cr_2O_3	1·70
Cu	trace.

Near the northern shore of Lake Nicolet— a short distance from the main road— a small pocket of chrome iron ore occurs. This, however, as well as an occurrence near the southeast side of the lake, cannot be said to be of any importance until development work is done.

In 1905 a magnetic survey was made of lot 7a, range V, township of Leeds, Province of Quebec: where a body of magnetite of considerable size was said to exist. Here, the ore occurs in pockets, only one of which is of sufficient size to attract attention. This ore formation continues in the next lot, 7b, range V, and it was to this lot and lots 1 and 3, range X, that I was instructed to confine my examination.

The rock and ore formation here are identical with that of lot 7a, range V. The ore occurs in a schistose rock and serpentine. The strike is very nearly NE-SW, with a dip to the northwest of about 45°. The ore occurs in small pockets of no economic value, and in some cases on this lot and on lots 1 and 3, range X, the magnetic indications are produced by buried boulders.

The iron ore in the vicinity of Kinnear Mills is not of sufficient quantity to warrant the construction of a railway through this part of the county of Megantic.

On the southern extremity of lot 7a, range V, township of Leeds, two pockets of exceptionally pure chrome iron ore were discovered and worked some years ago. In all, about 60 tons of ore were raised, and sold, it is said, to the Carnegie Steel Company, Philadelphia, at $25 per ton. When these pockets were exhausted, the workings were abandoned. It is, however, highly probable that systematic prospecting, if carried on, will disclose similar pockets, since the rocks in the neighbourhood of the original pockets carry considerable chromite.

OCCURRENCE OF MAGNETITE NEAR NAMEGOS ON THE MAIN LINE OF THE CANADIAN PACIFIC RAILWAY.

Information having been sent to the Mines Branch concerning a deposit of magnetic ore near Namegos—a station on the Canadian Pacific railway—which was said to be of large dimensions, and the ore of good quality, it was deemed expedient to send

a technical officer to make an examination. I was, therefore, instructed to make this investigation.

This occurrence is confined to lots W. D. 275 and 276, of 160 acres each, situated about seven miles in an easterly direction from Namegos station. To reach this property it is advisable to go by canoe up a small creek, as the tramp through the bush is difficult, owing to fallen timber and thick underbrush.

Very little of the main rock formation is exposed on this property, the principal exposures occurring on the summit of the highest hill. Here, two parallel ridges, separated by 150 feet, are exposed for a short distance. The rock is granitic and very coarse-grained. On a fresh fracture, large crystals of hornblende, feldspar, and biotite mica can be seen. Quartz is the least abundant mineral, but can be seen with the naked eye in places. The rock is readily decomposed, and on these exposures the weathering continued to considerable depth. To the east of these exposures a ledge of nepheline rock occurs at the foot of the hill. This is also found associated with the iron ore.

My instructions were to make a detailed magnetometric survey, if the indications warranted. Such a survey would have been difficult and would have consumed much time, as the ground is not only very uneven where the ore occurs, but is heavily covered with fallen timber, which would necessitate a great deal of cutting. The indications, however, did not warrant such detailed work.

In order to test the property with a view to making a detailed survey, a base-line, bearing N 25° E (magnetic) was cut for a distance of 1,200 feet from the corner post dividing the two lots. From the northeastern extremity of this base, three lines, bearing in an easterly direction, were cut 150 feet apart. These were connected with a line run along the base of the hill, connecting two outcrops; additional readings were taken between the outcrops. Observations with the magnetometer were made along all these lines, and the trail at intervals of 30 feet. In addition, many observations were taken in other parts of the property.

The magnetic attraction was found to be pronounced only in the immediate vicinity of the outcrops; while to the north, northeast, and south of the base-line the field was normal. Since the rock associated with the iron ore was found to contain about 8 per cent Fe, it is probable that some of the feeble attractions were produced by an underlying rock impregnated with magnetite.

The outcrops appear to represent small isolated deposits, connected in some instances by a band of rock carrying some magnetite. The area of the disturbed field is about 300 feet square, but only a part of this appears mineralized with iron ore.

Two general samples of ore from the two most prominent outcrops, and one of rock carrying iron, were taken for analysis. The following is the result of the chemical examination:—

	No. 1.	No. 2.	No. 3.
Fe	63·5	51·81	8·81
TiO_2	12·5	11·91	0·31

Sample No. 1 was taken from the most easterly outcrop; while samples Nos. 2 and 3 were taken at the foot of the hill.

From the preceding analyses of samples Nos. 1 and 2 it will be seen that the ore carries a large amount of titanic acid, rendering it of inferior quality. Sample No. 3 shows that the rock in the immediate vicinity of, and associated with the iron ore, carries about 9 per cent metallic iron, and a small amount of titanic acid. If the rock underlying the surface and connecting the outcrops carries this percentage of iron, the feeble attractions observed in certain portions of the field are readily accounted for.

The indications do not point to the existence of an ore deposit of magnitude, and hardly warrant the expenditure of much money for diamond drilling or development work.

MATTHEWS AND CHAFFEY IRON MINES, ONT.

Several reports have already been written on these mines, which were operated many years ago, but no detailed magnetic survey has ever been made. On the introduction—a few years ago—of the method of examining magnetic ore bodies by means of the magnetometer, requests were received at the Mines Branch for a technical officer to make such an examination. This summer I was instructed to examine both the Chaffey, and the Matthews iron mines, with a view—if indications warranted—to making a detailed magnetometric survey.

These mines are situated about one mile and a half from the village of Newboro. The Chaffey mine is on a small island about 500 feet square, in Mud lake, near its north shore, on lot 27, con. VI, township of South Crosby; and the Matthews mine on the main shore, about half a mile northward, on lot 1, con. VI, township of North Crosby.

As far as shipping facilities are concerned, these mines are admirably situated, having not only water communication by means of the Rideau lakes and canal to Lake Ontario, but also railway communication via the Brockville and Westport railway, which connects with the main lines.

Three large pits, with their long axis approximately parallel, constitute the main workings on the Chaffey mines. It was not possible, on account of water, to examine these workings; but the portions above water level show the pits to be separated by barren walls of rock. It is possible that these pits represent exhausted—or nearly so—ore pockets. Magnetometric observations taken at various points on the island indicate the existence of more ore; but on account of the small area apparently mineralized it was not deemed advisable to spend the time necessary to make a detailed magnetometric survey. The ore is said to contain over 9 per cent titanic acid.

At the Matthews—or Yankee mine, considerable ore was raised from a large pit about 300 feet long by 100 feet in width. It might be noted in passing that the long axis of this pit is approximately parallel to the long axis of the Chaffey pits. The pit was also full of water, thus preventing an examination of the workings. The direction of the long axis of these deposits is approximately east-northeast—west-southwest; this also represents the direction of the strike.

A preliminary magnetometric survey was made of this property, since the indications appeared more favourable. The results of the survey showed that while the ore at the old workings is very nearly exhausted, considerable ore appears to exist immediately to the south and southwest of the large pit. About 600 feet to the northwest of this pit, an area of strong vertical attraction of about 100 × 150 feet in extent, was found. This part of the property is overlaid to some depth by surface matter. The indications here, however, point to a pocket similar to those just described, and having the same general strike.

A detailed magnetometric survey of this entire property might disclose more pockets, some of which might prove of economic value. Such a detailed examination, however, was not considered practicable this summer, on account of the growing crops which it would have been necessary to tramp over, and the impossibility of obtaining efficient help in this locality during the summer months; owing to the great demand for guides by summer tourists.

The content of titanic acid in this ore is—according to an analysis made some years ago—12·32 per cent: and the ore, in addition to this, carries considerable sulphur: which deleterious ingredients together, render it an inferior ore for reduction in the furnace, except by electric smelting.

COEHILL IRON MINE ON THE CENTRAL ONTARIO RAILWAY.

The Coehill iron mine is situated at Coehill—a small village taking its name from the mine—which is the northern terminus of one of the branches of the Central

Ontario railway. Several years ago, mining operations were vigorously prosecuted here, and several hundred thousands of tons of ore raised. Since then little or no actual work has been done.

The workings consist of three shafts and an open-cut, all of which are in a bad state of repair. The workings at the time of my visit—and for a long time past, have been full of water, thus preventing an examination. About 30,000 tons of ore are stocked near the railway track, some of which is of good quality.

To determine the extent of the ore body, and, if possible, locate new pockets, a magnetometric survey was begun. It soon became apparent, however, that any detailed work in this direction was unnecessary, as the field in the vicinity of the shaft, in the northeast part of the workings, was perfectly normal, indicating an exhaustion of the magnetic ore in this vicinity. Between this shaft and the next one, in a southwesterly direction, the field also proved to be neutral. As an outcrop of a rust coated ore was approached, near the open-cut and second shaft, the field was found disturbed. Here, over a small area, some strong positive attractions were observed. This is simply a pocket of very limited extent. From this point on, over the remainder of the field, no disturbance due to the existence of ore was encountered; except when in the immediate vicinity of the open-cut.

Magnetometric observations were taken at many points on this property, but the indications were not favourable to the existence of any quantity of magnetic ore. As far as it was possible to determine from an examination of the walls of the workings exposed above the water line, the ore here appears to be very nearly exhausted. Several diamond drill holes have been put down on this property, but the logs of these were not available.

Jenkins Mine.

About 1,000 feet in a southwesterly direction from the Coehill mine, is situated the Jenkins mine, on lots 17 and 18, con. VIII. Here, a small outcrop of magnetite occurs, having a strike approximately the same as that of the Coehill mine, viz., NE-SW. The exposure has a very rusty appearance, due to the decomposition of iron pyrites, which the ore can be seen to contain.

This mine was worked some years ago by means of an open-cut, from which some ore was raised. Magnetometric observations were taken along the outcrop and in different parts of these lots, but the only pronounced attractions were found to occur in the immediate vicinity of the open-cut and outcrop. This occurrence does not, therefore, appear to be very promising.

OCCURRENCE OF IRON ORE ON LOT 22, CON. IX, TOWNSHIP OF WOLLASTON, COUNTY OF HASTINGS.

On lot 22, con. IX, there are indications of magnetic iron ore, which many in this vicinity believe points to a deposit of large dimensions. Some years ago this property was thoroughly prospected and examined by several engineers and intending purchasers, but the results of their examination and findings have never been made public.

The property has been prospected and partially developed by three pits sunk in the vicinity of outcrops. The outcrops have a rusty appearance, due to the decomposition of iron pyrites, and appear to be of the same composition and character as that common to the many occurrences of this region.

The geological formation is very similar to that of Coehill mine only a short distance to the northeast, and the ore occurs in practically the same manner—when it is possiblie to determine this from outcrops and exposures in pits, viz., in pockets. In one pit the ore is seen to occur as a vein of no great thickness, associated with a very pure limestone, and accessory minerals.

The general strike of the formation, mineralized with iron ore, is approximately NE-SW. To the east a granitic rock is exposed in some places, and is the principal rock of the region. Limestone occurs a short distance to the west, and also occurs, as stated above, associated with the ore in one of the pits.

The deepest pit at the time of my visit was full of water, but some of the ore raised in past years could be seen on the surface adjacent to the pit. A fine specimen of magnetite was taken from the most northeasterly pit, and sent to the World's Fair in 1893. Another sample taken from the same pit was said to run high in nickel, and to carry, in addition, gold and silver. No ore of this description was to be seen at the time of my visit.

Pyrrhotite is also said to have been found in another pit on this property.

The object of my visit was, to determine the extent of this alleged deposit, with a view to making a magnetic survey if the conditions warranted.

Magnetometric observations were taken over a line in the direction of the approximate strike of the different outcrops, and in many parts of the field.

According to these observations, the disturbed field, due to the presence of magnetite, was found to be of very small extent, and to always occur in the vicinity of an outcrop. The largest and only area where the vertical attraction was at all pronounced, is roughly 100 × 50 feet. Ore does not exist here, except in pockets, some of which appear to be too small to be of economic value.

Ricketts Iron Mine.

Magnetic iron ore is exposed on lot 17, con. XI, township of Tudor, Hastings county, in several places. About six pits have been sunk for testing purposes. These pits were supposed to lie on the strike of the ore formation, and were believed to tap the iron ore of one continuous body. The exposures occur on the east half of the lot and lie approximately in a line bearing NE-SW. Immediately to the southeast of these exposures, a granitic rock occurs, which is the principal rock of this place. To the northwest and about 350 feet from the pits, an exposure of limestone occurs.

When the underlying rock is exposed by stripping, it is seen in places to be banded with iron ore. These bands are very narrow and much contorted. When the iron ore occurs in this manner, it appears to be too lean even for concentrating purposes.

Magnetic observations taken at regular intervals along a line approximately in the direction of the strike, and on several lines at right angles to this, showed that the ore did not occur in one continuous body, but in a number of pockets. The disturbed fields produced by the existence of the ore body, or bodies, were quite pronounced in the vicinity of the outcrops or pits which uncovered ore, but the indications, as a whole, did not point to any lateral or vertical extension. A detailed magnetometric survey might prove one or two of these pockets to be of economic value. Before deciding to expend much money either in further development or diamond drilling, it would be most desirable to have such a survey made.

This property is situated about eight miles from the Central Ontario railway, the nearest station being Gilmour.

Several other occurrences of iron ore in this region have been reported upon, but with the exception of those previously mentioned, none can be considered to be of any value until some development work is done.

OCCURRENCE OF MAGNETITE ON LOT 21, CONCESSIONS 10 AND 11, TOWNSHIP OF FARADAY, COUNTY OF HASTINGS.

On the north half of lot 21, con. X, and the south half of lot 21, con. XI, township of Faraday, two iron ore claims have been staked. On both claims there are exposures of a rust coated magnetite. The claim on the north half of lot 21, con. X, does not appear to be of economic value, and will not be described here.

That on the south half of lot 21 is of greater extent, and the development work done here in the way of trenching allowed of better examination.

The strike of this formation is about NE-SW. The country rock is granite. The ore here occurs on the top and side of a hill, and the field produced by this ore body was traced by magnetometric observations for a distance of 400 feet down the side of the hill, and for a width at right angles of about 150 feet. It is not very likely that the mineralized area extends this entire distance, but it might be conservatively put at 150 feet long by about 90 feet wide. No reasonably accurate estimate, however, regarding the dimensions of this mineralized area can be made without a detailed survey, since the only exposure is on the top of the hill, and the trenching was not carried far enough to help much in this direction. A magnetometric survey made of this half of lot 21 might show the mineralized area to be large enough to prove of economic importance. This property is situated about seven miles from Bancroft and the Central Ontario railway.

Blairton Iron Mine.

Some time ago, a request asking for a magnetometric survey of Blairton iron mine was received at the Mines Branch, and since I was only a short distance from this place, while investigating the magnetic disturbances reported in the northeastern corner of Northumberland county, I took advantage of the proximity of Blairton to examine the property, with a view to making a detailed magnetic survey.

The Blairton iron mine is situated on lot 8, concession I, of Belmont, county of Peterborough, and was worked quite extensively some years ago. Since that time little or no actual work has been done.

The only workings—one a deep excavation about 250 feet long × 150 feet wide, and a smaller one a short distance south of the large one—were full of water; making an examination impossible.

The geological formation of this deposit is fully described in Sir William Logan's 'Geology of Canada,' page 676, and in the Report of the Royal Commission of Ontario, pages 127-130, and need not be repeated here.

Considerable prospecting has been done, and several test pits put down. Ore has been exposed in several of these pits, and the observations taken at many stations with the magnetometer point to the existence of considerably more ore.

The ore in the vicinity of the most southern pit seems to be very nearly exhausted, as the magnetic field in its vicinity is normal.

A detailed magnetometric survey was not made, as the ground is so broken by pits and excavations from which ore has been raised, that the magnetic field has become distorted.

OCCURRENCE OF MAGNETITE NEAR ST. JOHN, N.B.

On account of a discovery of an alleged deposit of iron ore, about eight miles from Gaspereau station on the Canadian Pacific railway, the assistance of the Mines Branch was sought for the purpose of locating positions for diamond drill holes. The intention was, to begin diamond drilling some time next winter, to prove the property.

The mineral rights covering 10,000 acres were granted to the discoverers of this occurrence.

The iron ore occurs in a quartz porphyry and consists of an exposure of hematite and magnetite in narrow veins. Neither of the veins is of economic value, and the parties interested were advised to discontinue further development work, either in the way of testing pits or diamond drilling.

CONCLUSIONS.

The theory advanced by some geologists—who examined, some time ago, the region embracing the iron ore deposits along, and in the vicinity of the Central Ontario railway—that the deposits of iron ore were igneous dikes and veins accompanying the igneous rocks, and that therefore, they were of deep rooted origin, and could consequently be worked in depth, is not of much importance to-day, since the theories on the genesis of ore deposits have been greatly altered, and, in some cases, wholly changed since that time.

The magnetic indications of those so far examined do not point to any considerable extension in depth. On some of these properties, which have been vigorously worked in past years, diamond drilling has been done, but in no case were the cores available. Had the cores been available for examination much light would have been thrown on the character of these deposits, which would be of great assistance in forming an opinion on similar occurrences.

The following are a few of the most promising deposits visited, and which the writer recommends as warranting further examination by means of a detailed magnetometric survey:—

The Matthews iron mine, lot 1, con. VI, township of North Crosby; Ricketts iron mine, on lot 17, con. XI, township of Tudor, Hastings county; and occurrence of iron ore on the south half of lot 21, con. XI, township of Faraday.

INVESTIGATION OF THE HARRIS PEAT GAS PROCESS.

The Harris gas process for generating gas from waste products, such as city garbage, manure, sawdust, and peat, has been more or less advertised by circulars setting forth the claims of the inventor. Recently, the attention of the Mines Branch was directed to this process by a Canadian business man, who for some years has been interested in peat, and who believed that much industrial benefit would be derived in Canada from the introduction of this process if the many claims set forth in the descriptive circulars could be substantiated.

After looking over the patent specifications and a description of the process, as set forth in the descriptive circulars above mentioned, it was at first decided that the process did not warrant an investigation by a technical officer of the Mines Branch; inasmuch as the principles involved precluded the possibility of generating gas from any of the above substances efficiently or economically. Since, however, the idea prevailed among a few interested in peat that the process was both economical and efficient, it was later deemed advisable in the interests of the peat industry of Canada, to make a detailed investigation of it, and if the process were found to be impracticable to publish the results with a view to preventing an addition to the long list of failures and consequent loss of money, which have resulted from the many impractical exploitations of peat bogs in Canada.

One of the most important claims made by the inventor for his process is that peat containing upwards of 75 per cent moisture can be treated in an ordinary gas retort, with an output of gas largely exceeding that made by the ordinary process from coal, and of a higher calorific value than that of coal illuminating gas.

The object, therefore, of the investigation was to test the process as thoroughly as possible, in order either to verify, or to disprove this and other claims as set forth by the inventor. No attempt will be made to discuss the commercial aspect of the process under any other conditions than those existing when the test was made. Unfortunately, the retort was not designed to allow of its being heated by the gas generated.

The demonstration plant, placed at our disposal by Mr. L. J. Harris, consisted of an ordinary single bench gas retort, which was heated by coke, with condensers, purifiers, etc., similar to those employed in the ordinary method of making illuminating gas from coal. The capacity of the gasometer was about 100 cubic feet, which necessitated the retorting of small charges of peat, viz., 20 pounds; since all measurements from the volume of gas produced were made with it, the weight of the charge had to be so taken that the gas evolved, after complete retorting, did not exceed the capacity of the gasometer.

DESCRIPTION OF PROCESS.

The process consists in the treatment of raw peat, containing upwards of 75 per cent of moisture, with a mixture composed of 40 gallons crude oil; 4 pounds ferrous sulphate; 4 pounds caustic potash; 4 pounds caustic lime, and sufficient flour and water to emulsify the mixture. Ten gallons of the mixture, according to Mr. Harris' patent specifications, or 12 gallons, as recommended by him personally (the latter quantity was used by us) is sprinkled or sprayed on a ton of the raw peat, which is then ready for retorting.

The peat bog at Alfred, owned by the Government, was frozen at the time of this investigation, hence it was impossible to send our own peat for the test, as was originally planned. The peat used was that obtained by Mr. Harris from a bog near Newark, N.J. It was fibrous, and contained petroleum. This latter was shown on the analysis of a sample taken for examination in our laboratory.

All gas analyses and determinations of the calorific value per cubic foot were made at the plant in Newark. An Elliot apparatus was employed for making the gas analyses, and the Junker's calorimeter for the determination of the heating value.

The analyses of the samples of peat; the retort residue; the oil extraction, and the determination of the calorific value of the peat and oil used were made in the laboratory of the Mines Branch. All samples for analysis were taken by Mr. M. F. Connor, Assistant Chemist to the Mines Branch, who made all the gas analyses at Newark, and later, the remainder of the determinations in Ottawa.

The Test.

The duration of the test was 8 hours and 5 minutes: during which time 80 pounds of raw peat, treated with oil and chemicals, according to the patent specifications, were retorted. Measurements were made of the quantities of gas produced and of coke consumed for heating the retort. Samples of the gas produced; of the cinders after retorting, of the oil used; and the peat before and after treatment with the mixture of oil and chemicals, were taken for analysis.

The Inventor's Claims.

(1) That peat containing upwards of 75 per cent moisture, rendering it unfit for other purposes on account of the large amount of heat necessary to evaporate the moisture can be utilized by means of this process, yielding a superior gas for light, heat, and power.

(2) That one ton of peat containing upwards of 75 per cent moisture, when treated according to this process, will produce 12,000 to 14,000 cubic feet of gas, and will have a candle power nearly double, and a calorific value of one-third to one-half more than that of city gas.

(3 That by means of this process a charge of waste material, such as peat, can be retorted in less than half the time required to retort a similar quantity of coal—thereby saving enormously in time, fuel, and labour, as well as tremendously increasing the output.

(4) That the heating of the retorts to generate the gas can be accomplished by the consumption of not more than one-third the amount of the gas produced in the retorts themselves—once the operation is started.

(5) That a plant has been erected at No. 197 Vandepool street, Newark, N.J., which is in operation, proving the great commercial value of the Harris process, where all the above-mentioned claims can be readily substantiated.

(The other claims made by the inventor do not need consideration here.)

RESULTS OF THE TEST.

Analysis of the Gas.

Four samples of gas were collected for analysis from the last four runs; but since all the analyses agree more or less closely, only the analysis of the sample collected during the last run will be given. It should be mentioned here, that five runs were made: the first two consisting of 10 pound charges of peat, and the last three of 20 pound charges.

The analysis of the gas produced is as follows:—

	Per cent.
Heavy hydrocarbon vapours	5·00
Illuminants	8·70
Oxygen	0·80
Carbonic oxide	8·00
Carbon dioxide	5·00
Marsh gas (CH_4)	19·00
Hydrogen	40·84
Nitrogen	12·66
	100·00

The calorific value of the gas calculated from the above analysis is 669 B. T. U. per cubic foot; and that determined by Junker's calorimeter 675 B. T. U. per cubic foot, which is a very close check. This is, however, high, and the average calorific value of all the runs, viz., 640, will be used in the calculations.

A proximate analysis of the retort residue gives the following quantities:—

	Per cent.
Volatile matter	26·60
Fixed carbon	48·00
Ash	25·40

The residue, although containing a large amount of combustible material, was in such a finely divided condition when withdrawn from the retort, that it could not be put to any commercial use; such, for instance, as the coke resulting from the gasification of coal when manufacturing town gas.

The percentage of ash in the peat treated with oil and chemicals was 2 per cent.

Oil Extraction.

As mentioned above, the peat before treatment with the oil and chemicals was found to contain petroleum. From several analyses of the samples taken at Newark the quantity of petroleum contained was found to be 13 per cent, by weight, of the peat freed from water.

The following table of results has been calculated to show the quantity of gas, etc., that would result from the retorting of 80 pounds of peat, and that which would result, were 2,000 pounds of peat retorted:—

Tests.	Peat actually retorted, 80 lbs.	Per ton (2,000 lbs.) of raw peat (calculated).
Moisture content	75 %	75 %
Dry peat substance	20 lbs.	500 lbs.
Water contained	60 "	1,500 "
Oil added with chemicals	4·32 "	108 "
Oil found in raw peat	2·60 "	65 "
Total oil in peat	6·92 "	173 "
Calorific value per lb. of dried sample of peat with oil extracted	8,215·00 B.T.U.	8,215·00 B.T.U.
Calorific value per lb. of oil used	19,080·00 "	19,080·00 "
Amount of peat coke residue	1·50 lbs.	37·5 "
Calorific value per lb. of the peat coke residues	11,160·00 B.T.U.	11,160·00 "
Cubic feet of gas produced	346·00	8,650·00
Calorific value of gas per cubic foot, average	640·00 B.T.U	640·00 B.T.U.
Amount of chemicals mixed with the peat	0·15 lbs.	3·00 lbs.
Coke consumed in heating retort	200·00 "	
Coke consumed for retorting only	94·00 "	2,306·00 "

The following calculations are made to show the distribution of heat units among the substances composing the charge to be retorted, and also the percentage of heat units supplied to the gas by the oil.

Heating value of the raw charge put into retort:—

Peat, 20 lbs (dry substance)	8,215 × 20	=	164,300 B.T.U.
Oil, 6·92 lbs	19,080 × 6·9	=	131,658 "
Total			295,958 "

Heating value of gas produced and peat coke residue:—

346 cubic feet of gas	346 × 640	=	221,440 B.T.U.
1 5 lbs. peat and coke	11,160 × 1·5	=	16,740 "
Total			238,180 "

Percentage of the total heat units of charge supplied by the oil contained $\frac{131,652}{295,958} = 44{\cdot}4\ \%$

Ratio of the heat units of the oil supplied to the total heat units of the gas produced $\frac{131,652}{221,440} = 59{\cdot}4\ \%$

The following calculation is made to show the amount of heat absorbed in raising 60 pounds of water from 62° F. to steam (212°) at atmospheric pressure. Sixty pounds of water is the actual amount which was contained in the total weight of peat retorted.

The total heat of atmospheric steam raised from one pound of water supplied at 62° F. is 1116·6 B.T.U., and, therefore, 1116·6 × 60=66996 B.T.U.: which is the amount of heat necessary to theoretically evaporate 60 pounds of water.

Since the gas produced from one gallon of oil by the Pintsch process is 90·03 cubic feet,[1] with a heating value of about 1390 B.T.U. per cubic foot, the heating value of gas produced from one gallon of oil would be:—

$$1390 \times 90{\cdot}03 = 125{,}141{\cdot}7 \text{ B.T.U.}$$

and since the total amount of oil contained in the peat retorted was 0·788 gallons, or 6·92 pounds,

$$125{,}141{\cdot}7 \times 0{\cdot}788 = 98{,}612 \text{ B.T.U.}$$

will represent the heat value contributed to the gas by the oil.

[1] 'Engineering Chemistry,' Stillman, p. 173.

The heat value of the gas supplied by the peat alone would then be:—

221,440—98,612 = 122,828 B.T.U.

and, after supplying the heat necessary to evaporate the water contained in the peat—which takes no part in the process other than to absorb a large amount of heat—the total heat value of the gas remaining would be:—

122,828—66,996=55,932 B.T.U.;

about 25 per cent of the heat value of the gas generated from the peat mixed with oil.

To maintain the temperature of the retort necessary for gasifying dry peat—while retorting, and when withdrawing old and introducing new charge—the remaining 55,932 B.T.U. would not be sufficient.

The above calculations are theoretical, and must not be taken as the results which might be expected in ordinary practice. In practice, the above calculated consumption of heat for evaporating the water contained in the charge and heating the retort would be far exceeded on account of the heat carried off by chimney gases, and loss of heat by radiation from the surfaces of the furnace and setting. For example, the loss of heat in chimney gases and loss from radiation in a bench of 7 retorts heated by coke, which was investigated by Euchêne, amounted to 56·5 per cent in the case of the former, and 15·3 per cent in the case of the latter; or together, about 72 per cent of the heat produced by the combustion of the coke used to heat retort.[1] In the present case this would leave about 28 per cent of 55,932 B.T.U., or 15,660 B.T.U. for heating retorts, together with their contents and products.

The amount of coke actually consumed for retorting only, which includes, of course, the heat required for evaporating the water in the peat, was 94 pounds; and assuming the heat value of the coke to be 14,000 B.T.U. per pound, the heat required for retorting the wet peat was 94 × 14,000=1,316,000 B.T.U., which exceeds by about six times the heat value of the gas produced. It may be noted that the heat value of the gas after making the above deductions, available for retorting, is only 55,932 B.T.U., which is very inconsiderable when compared with the heat units supplied by the coke.

No reference will be made here to the fuel consumed for heating the retort between charges, since the time rquired for this operation might be much shortened in ordinary practice.

Although the gas produced was of good calorific and illuminating value, it will readily be seen that, in no sense can it be described as an economic process. The peat coke produced—which would amount, per ton of wet peat retorted, to about 37·5 pounds—retains the form of peat, which, when quenched with water, falls into small particles, hence has no commercial value.

The time required to retort 80 pounds of peat, containing 75 per cent moisture, was 3 hours and 48 minutes; while that required to retort 400 pounds of coal would be about 4 hours.

Before concluding, it may be mentioned that many experiments have been made and many processes tried for generating illuminating gas from peat in European countries not so abundantly supplied with coal as the United States and Canada; but that all these processes proved uneconomic when coal was at all accessible. 'In general, however, peat will not be distilled or carbonized with obtaining gas for illuminating purposes as the primary object. But the gas which results as a secondary product when compressed and dried peat is distilled, as in Austria, for the sake of the charcoal or coke, and tarry and nitrogenous products; or when the peat is carbonized, as in Russia, for the production of coke for use as a fuel, may well be

[1]Gas Manufacture, a Practical Handbook, by W. J. A. Butterfield, M.A., F.I.C., pp. 81-82.

utilized locally for lighting by the aid of mantles."[1] In this latter case, the gas produced is a by-product, as in the case when making blast furnace coke.

Perfectly dry compressed peat yields at a red heat 11,000 cubic feet of gas per ton, and nearly 900 pounds of coke, as well as 15 gallons of tar, and a quantity of ammoniacal liquor.[2]

CONCLUSIONS.

(1) The water contained in the peat is not utilized in the production of gas, since it is entirely evaporated before the carbon in the peat becomes incandescent, or even red-hot, and passes off immediately into the condenser as soon as it is vaporized. The formation of water gas cannot, therefore, take place, since the water vapour can in no way come into contact with the hot carbon.

(3) One ton of peat, containing 75 per cent moisture, produced 8,650 cubic feet of gas, which had a calorific value of 640 B.T.U. per cubic foot, or about equal to that of city gas, and 37 pounds of peat coke of no commercial value.

(3) The time required to retort 80 pounds of peat was 3 hours and 48 minutes, or about equal to the time required to retort 400 pounds of coal.

(4) No arrangement existed at the plant investigated for heating the retort by the gas generated; but the gas remaining after deducting the heating value contributed by the oil is in no sense sufficient to evaporate the large amount of water, and retort the charge.

(5) The operations—mechanical and thermic—of the plant visited and tested at Newark, N.J., in no sense proved this process to be economical, or the products of commercial value, in fact, none of the claims investigated were substantiated.

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[1] Gas Manufacture, a Practical Handbook, by W. J. A. Butterfield, M.A., F.I.C., page 8.
[2] Ibid, p. 9.

PRELIMINARY REPORT ON THE PEAT BOGS OF CANADA.

A. Anrep.

In accordance with instructions, I continued, during the season of 1909, a thorough investigation of peat bogs of Ontario, in order to ascertain the extent, depth, and quality of the peat contained therein.

The bogs first investigated were those for which petitions had been received, asking for examination, and others favourably located as regards transportation, and a convenient market.

As part of the season was required for the development of the Alfred peat bog, and as a systematic investigation of a peat bog occupies considerable time, only a few bogs were examined.

During the season of 1909 the following bogs—all located in the Province of Ontario—were investigated:—

(1) The Brockville peat bog, situated two and a half miles northwest of Brockville, in Leeds county.

(2) Komoka peat bog, situated in Lobo and Caradoc townships, Middlesex county.

(3) The Brunner peat bog, situated in Ellice township, Perth county.

(4) The Rondeau peat bog, situated in Harwich township, Kent county.

(5) Part of Alfred peat bog—the Government property—300 acres, more or less, in Alfred township, Prescott county.

Part of July, the months of August, September, and part of October were spent at Alfred, superintending the erecting of the peat plant.

The Anrep peat machine, with auxiliary conveyer and platform—which was imported from Sweden in 1908, and used for manufacturing peat fuel at Victoria Road—was moved during the past summer to Alfred, where it is now installed, together with other machinery imported recently from Sweden and Germany, making a complete plant for the manufacture of air-dried peat.

While this plant was being installed, the following work was also carried on:—

Drainage of Alfred Peat Bog.

	Cubic yards.
(1) Main ditch, 3,125 feet long, 6 feet wide at the top and 2 feet at the bottom, by 9 feet deep.	4,166
(2) Parallel ditch to the main, 2,800 feet long, 4 feet wide at the top, and 2 feet at the bottom, by 4 feet deep. . . .	1,615
(3) Covered in ditches, 6,000 feet long, 2 feet wide at the top, and 1′-4″ at the bottom, by 3 feet deep.	1,111
(4) Open ditches, 3,000 feet long, 2 feet wide at the top, and 1′-4″ at the bottom, by 3 feet deep.	555
(5) Water course ditches, 4,000 feet long, 3 feet wide at the top, and 1′-6″ at the bottom, by 4 feet deep.	1,333
(6) Enlarging ditches, 5,000 feet long, 2 feet wide at the top, and 1 foot at the bottom, by 2 feet deep.	555
Total cubic yards of drainage during months of August and September.	9,335

The following buildings were constructed at the Alfred peat bog:—

Buildings.

(1) Peat shed, for storage of dried peat, 160 feet long, 22 feet wide, and 18 feet high.
(2) Tool shed and blacksmith's shop, 22 feet long, 13 feet wide, and 7 feet high.
(3) Office, 16 feet by 16 feet by 8 feet high.
(4) Movable housing for peat machine, 22 feet long, 8 feet wide, and 10 feet high.

During September I attended the meeting of the American Peat Society, held at Boston, Mass., U.S.A. In October, I shipped from Victoria Road about 70 tons of last year's peat to the gas producer plant which is under construction at Ottawa.

Details of the investigation of the above-mentioned bogs, together with diagrams and maps, will be included in a special report, to be issued as Bulletin No. 2, entitled, 'Investigation of the Peat Bogs and Peat Fuel Industry of Canada.'

COLLECTION OF DATA ON COAL MINING IN NOVA SCOTIA.

Joseph G. S. Hudson.

The greater part of 1909 was occupied in working on my report on coal mining in Nova Scotia; this report comprises 1,621 pages of manuscript, and with the numerous photos, drawings, and maps, will make a volume of considerable magnitude. The following is a short syllabus of the contents:—

Area and extent of the coal field. Early history of mining in Nova Scotia. Development and expansion of the coal trade. Coal companies, railways, and shipping piers. Descriptive articles on the works and mines of the coal companies operating in the Province of Nova Scotia. Mode and method of working coal; sections of the coal seams, together with information and data on coal cutting, haulage machinery, and general appliances. Accidents in mines; the use of safety explosives, and rescue stations. Tabulated rates of wages and employes' contracts. On screening and coal handling appliances; also on the improvement in value of secondary coals, by means of wash plants. Advisability of indirectly transforming slack coal into electric energy at the mine for transmission to manufacturing centres. The working of coal seams under submarine areas.

Immediately after submitting the above-mentioned report, I started out to procure information on the Draeger rescue apparatus for oxygen breathing in mine rescue work, and visited the central rescue station of the Dominion Coal Company, at Glace Bay, Cape Breton. While in this region I visited the coke ovens and by-product plant of the Dominion Iron and Steel Company, Sydney, with a view to obtaining data on coke making and coke oven construction. I also inspected the coke oven system of the Nova Scotia Steel and Coal Company at Sydney Mines, which is of the Bauer and Bertrand type. At Inverness, Cape Breton, I investigated the application of the longwall method to submarine coal mining in operation there, in order to supplement the data already incorporated in my report on Nova Scotia coal mining. A visit to the Pictou coal field also resulted in the collection of further data of importance.

Upon returning to Ottawa again (Nov. 1), I at once began—in accordance with your urgent instructions—to prepare and arrange in systematic form, information on explosives already collected, to enable the Department to draft a bill for regulating their manufacture and use.

A preliminary report on Accidents in Mines has been compiled and is submitted herewith. The subject of mine accidents has also been attracting a great deal of public attention in the United States, and the Government of the United States has recently employed a committee of three foreign experts from Europe, to investigate coal mine accidents, their cause and prevention. This report is of far-reaching importance; and since coal mining conditions in Canada and the United States are very similar, it has been deemed desirable to publish it as an appendix to this report.

PRELIMINARY REPORT ON ACCIDENTS IN MINES.

In accordance with your instructions to make a formal report on Accidents in Mines and on the use of Explosives, I herewith submit the data and information which I have gathered within the short time at my disposal.

In the first place, I deem it my duty to draw your attention to the lamentable fatalities in the coal and metalliferous mines of Canada.

Mine accidents, and the fatalities due to the careless use of explosives, have attracted intense interest in the United States, leading recently to the formulation of drastic measures for the prevention thereof: the deplorable condition of affairs in Canada is so similar to that of the United States that effective measures for the prevention of the serious loss of life and limb cannot be delayed.

In Europe, where mining has been carried on for centuries, hard earned experience has led to the formulation of wise rules and regulations, with consequent decrease in loss of life.

In view, therefore, of what is being done at the present time in the United States, and what has already been done in Europe, Canada cannot afford to take any subordinate position in this matter.

ACCIDENTS IN MINES.

In the year 1855, in the United Kingdom, a commission was appointed to investigate and report on accidents in mines and their causes, and to suggest necessary legislation for lessening the great loss of life among mine workers.

With this object in view, skilled mining engineers of known integrity were appointed as inspectors of mines: men whose training had been practical, both in regard to their knowledge of mining conditions as they actually exist, and because of their acquaintance with the men to whom the proposed laws apply.

That the laws governing the regulations of mines, both in coal and metalliferous mining, were effective is apparent from the fact that in the coal mines of Great Britain the death rate has been reduced as follows:—

	Average 10 years.
Years 1873 to 1882, the death rate per 1,000 men employed, was	2·24
1883 to 1892	1·81
1893 to 1902	1·39
	Average.
1903, 1904, 1905, 1906, 1907	1·29

	Average 10 years.
Taking the same period for metalliferous mines, 1873 to 1882, average death rate per 1,000 men employed, was	1·62
1883 to 1892	1·44
1893 to 1902	1·31
	Average.
1903, 1904, 1905, 1906, 1907	1·08

From the foregoing figures it will be seen that there has been a steady decrease in the death rate per 1,000 men employed in the mines of the United Kingdom: but the reverse is the case both in the United States and Canada.

In Bulletin No. 333 of the United States Geological Survey—issued in 1907 by the Technological Branch—which deals with coal mines accidents, their causes and prevention, it is emphatically stated that the large increase in the production of coal probably accounts for the increased death rate per 1,000 men employed; but the following table, giving the number of men killed for each 1,000 men employed, shows that the increase cannot be accounted for in that way:—

Year.	Deaths per 1,000 men employed.
1895	2·67
1896	2·79
1897	2·34
1898	3·59
1899	2·98
1900	3·24
1901	3·24
1902	3·49
1903	3·14
1904	3·38
1905	3·53
1906	3·40
1907	4·86

'It has already been stated that in no country in the world are the natural conditions so favourable for the safe extracting of coal as in the United States, and it has also been pointed out that in spite of this fact the number of lives lost per 1,000 men employed is far higher than in any coal-producing country in the world.

It now remains to be shown that unless energetic means are taken to counteract this prevailing tendency, not only will the death rate, in proportion to men employed, and tons produced, increase as it has done in the last few years, but it will increase at a much more rapid rate.'

Such was the condition of things in the United States in 1907, but it will be shown hereafter that energetic measures have been adopted for the prevention of mine accidents.

Upon turning to Canada for the purpose of comparison, as regards the death rate per 1,000 men employed in coal and metalliferous mines, it can be truthfully asserted that we compare most unfavourably.

British Columbia and Nova Scotia are the two Provinces in which coal and metal mining have been carried on more extensively than in any of the other provinces.

The following statement shows the death rate per 1,000 men employed in coal mines:—

British Columbia.

Year.	Per 1,000 men employed.
1899	2·91
1900	4·06
1901	*25·67
1902	†34·65
1903	9·85
1904	8·31
1905	2·72
1906	3·12
1907	5·11
1908	2·95

An average death rate for ten years of 9·21 per 1,000 men employed, as against 1·29 in the United Kingdom.

* Wellington mine disaster. † Fernie mine disaster.

Nova Scotia.

Year.	Per 1,000 men employed.
1899	3·39
1900	3·17
1901	1·82
1902	2·60
1903	2·88
1904	2·40
1905	1·85
1906	2·39
1907	3·05
1908	3·48

An average death rate for ten years of 2·67 per 1,000 men employed, as against 1·29 in the United Kingdom.

It is generally supposed, but without adequate foundation, that a great many more men are killed in coal mines than in metalliferous mining. This, however, is not correct, as the following statement will show; and this fact should be emphasized in view of the coming era of metalliferous mining in the Province of Ontario.

Comparative Records.

Death rate per 1,000 men employed.	1906.	1907.	1908.
British Columbia :—			
Coal	3·12	5·12	2·95
Metal	4·57	5 51	5·93
Ontario :—			
Copper and nickel	2 45	2·19	
Silver and iron	2·84	7·36	
Nova Scotia :—			
Coal	2·31	3·05	3·48
Metal	11·61	4·14	

With regard to the Province of Ontario, however, in 1908 the record for one section of the Province seems so alarming that special attention is directed thereto. In making comparisons with the statistics from other districts, however, it must be recognized that in Ontario practically every accident, excepting a few in the more remote districts where only prospecting is in progress, is recorded, but only very imperfect records of the number of men employed on the properties are obtainable. Hence it becomes difficult to reduce the accidents, fatal or otherwise, to the usual ratio per 1,000 employed.

In the report of the Bureau of Mines for 1908, Mr. E. T. Corkill, the Inspector of Mines, devotes considerable space to accidents in mines, especially in the Cobalt district. From tables published on pages 69 and 70, we learn that the number of fatal accidents in the district was thirty, twenty-seven of which took place underground. Of these twenty-seven fatalities, thirteen took place in silver producing mines[1] and fourteen in non-producing mines of the district, several of the latter being accidents in prospecting shafts.

[1] Figures supplied by T. W. Gibson, Deputy Minister of Mines.

On pages 13 and 14 of the same report it is stated that there were 1,089 underground workers and 1,325 above ground in the silver producing mines, a total of 2,414 employes. Since the provincial returns show thirteen fatalities among 1,089 employes underground, the ratio for these silver producing mines becomes 11·94 per 1,000 men employed underground. No data being available as to the number of men employed underground on those properties which are classed as non-producing, no ratio can be determined for this class of accident, but it may be assumed that the number of men employed in these properties was less than in the producing mines with a correspondingly higher ratio of fatalities. The total number of men employed in the district was between 3,500 and 4,000.

An examination of the statistics of mining accidents, in the British colonies and in foreign countries, as published in a report by the Home Office, Part IV, Colonial and Foreign Statistics, 1907, to the British government, showed no record as high as 11·94 fatal accidents per 1,000 employes.

In the Transvaal, where Kaffir labour is employed, the death rate per 1,000 men employed (in 1906) was five. This was deemed so alarming that a Royal Commission was instituted at once.

For comparative purposes, accidents are classified as shown in the following German schedule, and since Ontario is under review, it will serve a useful purpose to compare them.

Accidents.

Classification.	Germany 1906.	Ontario 1906.
	Per cent.	Per cent.
Accidents owing to danger inherent to the work itself	69·31	44·7
" due to defects in the mine workings	00·78	31·9
" through fault of fellow workmen	3·24	8·5
" through fault of injured person	26·67	14·9

The manifest conclusions to be drawn from the above are as follows:—

(1) That the class of work is not as dangerous in Ontario as in Germany.

(2) That the management of the Ontario mines has much to answer for as regards the loss of life.

(3) That the workmen in Ontario mines will compare favourably with the German workmen.

The foregoing facts indicate a lamentable state of affairs, as regards loss of life and limb in Canadian mines; and the seriousness of the situation demands that instant action be taken to provide a remedy.

SUGGESTED REMEDY.

At present, provincial governments have the power to enact the laws and regulations for mines, and for the gathering of mining statistics, a condition which, evidently, is not giving satisfactory results. Better results can possibly be obtained by the Federal Government passing legislation whereby it can co-operate with the several provinces, to ameliorate these conditions.

This question may evoke discussion, and even objections, but it can be proven that this dual tendency in the United States—making for co-operation between the Federal Government and the respective State Legislatures—is an object lesson for Canada, since there is a striking parallel as regards mining and operative conditions between

the two countries. The remarkable feature about the movement in the United States is that the initiative began with the States themselves and not with the Federal Government.

This was due to the fact that, for political and other expedient reasons, it was found in practice that the local authorities failed to carry out the provisions even of the existing rules and regulations, hence, due to laxity and looseness of administration, serious accidents, and deplorable loss of life began to increase to an alarming extent.

It was seen, therefore, that strong measures were needed, backed by the sanction of the supreme government authority of the American Commonwealth.

In the United States, Mr. George Harrison, the Chief Inspector of Mines for the State of Ohio, in his annual report, 1908, has a long article on the duties of the Federal and States Governments in relation to the mining industry, and a short paragraph is here quoted as being applicable to Canada.

'In June last a gathering of mine inspectors from various mining states convened in the city of Indianapolis and after considering the seriousness of the situation from increased fatalities in mines, decided to organize an Institution of Mine Inspectors of the United States, with the object in view of mutual assistance and more complete co-operation and concerted action, in securing better and more uniform mining laws.

'While a movement of this kind is in the right and proper direction, and should be encouraged and sustained, there is no doubt a large number of those who favour it go further, and believe that any steps in the direction of better and safer regulations of the operations of mines, to be general and successful, should be of a *national* character, having the *moral* and *material* support, and carrying with it the impetus of the *Federal Government*.

'There may be some differences of opinion as to whether representatives of the Federal Government can exercise any jurisdiction and authority in mines in the various mining states, or what the effect would be on state mining departments, but there is no need for such questions to arise.

'A Federal Bureau of Mines could do very efficient work by investigations in many directions, and in co-operation with state mining departments, without breaking down any of the state constitutional barriers, or in any way interfering with the authority of state mining inspectors in the proper performance of their duties.'

EXPLOSIVES AND THEIR USE.

Canada has not at the present time what may be called an 'Explosive Act,' such an Act as was passed in the United Kingdom in 1875 (38 Vict., C. 17), whereby the manufacture, storage, carriage, testing, and use of explosives are controlled by the Imperial Government.

The Chief Inspector of Explosives for the United Kingdom, in his official report for 1908, makes the following statement:—

'That notwithstanding the large increase in the manufacture of explosives, the average number of deaths has greatly decreased since the passing of the Explosives Act, whereas the number of fatal accidents with explosives under conditions to which the Act does not apply appears to increase with the extension of trade.'

That the question of explosives has a direct bearing on accidents in mines is obvious from the action taken by President Roosevelt (Senate Records, U.S.A., January 28, 1908, page 1179), when the causes of the large number of accidents occurring in the United States mines were brought to his attention.

In 1908 the United States Government appointed a special commission, consisting of 'Foreign Experts,' to investigate the causes of mine accidents, and to suggest a remedy for the same, namely:—

Victor Watteyne, Inspector General of Mines, Belgium.
Carl Meissner, Councillor for Mines, Germany; and
Arthur Desborough, His Majesty's Inspector of Explosives, Great Britain.

This Committee submitted their report to Secretary Garfield on October 23, 1908. who transmitted it to President Roosevelt, stating that the report with its recommendations would be of the highest importance in aiding Congress, and the different State Legislatures, in enactment of laws and regulations for more effective and careful operations in mining, and thus prevent the serious loss of life which has occurred in recent years.

On the presentation of this report to President Roosevelt, he at once ordered its publication and distribution among the coal mine operators and miners of the United States.

The first recommendation made in the report is marked 'A,' and is headed 'Selecting the Explosives to be used.' It reads as follows:—

'We recommend that the Government of the United States examine the explosives now and hereafter to be used in mining, with a view to eliminate the most dangerous explosives, and to improving and standardizing such explosives as may be consired most suitable for such use; these to be designated as '*Permissible Explosives.*'

That the United States Government took active steps in carrying out in a practical manner the recommendations of the 'Foreign Experts' is demonstrated by the fact that the Technologic Branch, established under the Geological Survey of the United States, straightway built a testing station at Pittsburgh, and made their experiments, which enabled them to issue their first official circular on May 15, 1909, only seven months after the recommendations were submitted to the United States Government.

In all European countries the Federal Governments have established 'Testing Stations' for proving explosives, and experimenting therewith.

In Canada we have no such station, though all the reports of the mining bureaus of the Provincial Governments draw attention to the large number of deaths and accidents due to explosives, while the press of the country is almost daily recording deaths due to this cause.

On railway construction work we have the same lamentable condition of affairs as exists in connexion with mining. On one section of the Grand Trunk Pacific railway there was a record of seventeen fatal accidents in one year.

In the year 1908 the report of the Inspector of Mines for the Province of Ontario records thirty accidents due to explosives, which is 58·82 per cent of all the accidents reported. In British Columbia for the same year eleven fatal accidents occurred in metalliferous mines, due to explosives, which is 52·4 per cent of all fatal accidents recorded in metal mines in that Province.

These facts do not require comment, they speak forcibly for themselves.

In the preparation of the foregoing case for a reform of the laws relating to effective regulation of mining operations, and the general use of explosives, it has been very difficult to obtain reliable data, due to the fact that there is no systematic collection of information in the Dominion by any central authority.

The statistics gathered by the mining bureaus of the respective provinces are not available for use by the Dominion Government until many months after the accidents have happened. If, however, it is necessary for the railway companies in the Dominion to report all accidents—no matter how slight—to the Board of Railway Commissioners of the Federal Government, who have authority granted by Act of Parliament to investigate any or every case reported, why should not like authority be vested in the Department of Mines?

No uniform system of classification exists in any of the provinces of Canada for the collection of statistics of accidents in mines, their cause and results; or as to how long an injured or disabled person is prevented from following his daily occupation.

In Great Britain this problem has been solved by the adoption of uniform laws and regulations, administered under the direct authority of the Home Secretary.

In the United States the mine inspectors of the various states are a unit in appealing to the Federal Government for the enactment of uniform mining laws adapted to conditions in the United States.

The proposed legislation is based upon the suggested remedies contained in the report of the special commission of 'Foreign Experts' already referred to.

In one respect Canada is already ahead of the United States, namely, it has established a Department of Mines, with authority to investigate the mining and metallurgical resources of the Dominion; but, unfortunately, at the present time, there is no legislation regulating mining and other similar operations, whereby it is possible to insist upon efficient measures for the prevention of injuries and loss of life in the various industries.

What is needed is an amendment of the 'Geological and Mines Act,' giving to the Mines Branch authority to call for the immediate reporting of accidents; powers to co-operate with mining authorities in the formulation of an efficient code of laws and regulations relating to mining and the use of explosives; and with sanction to verify statements and to investigate causes.

SUGGESTIONS FOR AN EXPLOSIVES ACT.

With regard to explosives, as already stated, no Federal Act exists.

In this respect Canada stands unique; for in every other civilized country laws relating to explosives have been enacted.

It is an interesting fact that all the European countries have based their laws relating to explosives on the British code of 1875, modified, of course, to suit local conditions.

Two reasons have been assigned for the almost universal adoption of the British code:—

(1) Because it was not only the first, but, being based upon wide experience of mining conditions throughout the empire, its provisions were wisely conceived.

(2) The results in the prevention of injuries and loss of life have been so satisfactory as to be the admiration of all nations.

STATEMENT showing Fatal and Serious Accidents in the Coal Mines of British Columbia and Nova Scotia, and comparative statement of the Fatal Accidents in Great Britain and the United States of America.

Year.	British Columbia. — Output of Coal in Tons.	British Columbia. — Number of Men Employed.	British Columbia. — Accidents.			British Columbia. — Ratio per 1,000 Men Employed.			Nova Scotia. — Output of Coal in Tons.	Nova Scotia. — Number of Men Employed.	Nova Scotia. — Accidents.			Nova Scotia. — Ratio per 1,000 Men Employed.			Great Britain. — Fatal Accidents, Ratio per 1,000 Men Employed.	United States. — Fatal Accidents, Ratio per 1,000 Men Employed.
			Fatal.	Serious.	Slight.	Fatal.	Serious.	Slight.			Fatal.	Serious	Slight.	Fatal.	Serious.	Slight.		
1899	1,306,324	3,780	11	29	30	2·91	7·67	7·94	2,642,333	5,612	19	26	4	3·39	4·65	0·07	1·26	2·98
1900	1,590,179	4,178	17	43	38	4·06	10·09	9·07	3,238,245	6,626	21	18	13	3·17	2·17	1·20	1·30	3·24
1901	1,691,557	3,974	102	34	31	25·67	8·59	7·88	3,625,365	7,663	14	33	8	1·82	4·30	1·04	1·36	3·24
1902	1,641,626	4,011	139	21	18	34·65	5·23	4·48	4,366,869	8,062	21	26	12	2·60	3·22	1·49	1·24	3·49
1903	1,481,913	4,264	42	33	26	9·85	7·74	6·09	5,255,247	11,092	31	64	9	2·88	5·76	0·81	1·27	3·14
1904	1,685,698	4,453	37	41	16	8·31	9·20	3·59	5,247,135	11,659	27	55	33	2·40	4·71	2·83	1·24	3·38
1905	1,825,832	4,467	12	30	26	2·72	7·03	5·90	5,050,420	10,780	20	55	19	1·85	5·10	1·76	1·35	3·53
1906	1,899,076	4,805	15	36	32	3·12	7·49	6·66	5,866,605	12,123	29	58	16	2·39	4·79	1·32	1·29	3·40
1907	2,219,608	6,059	31	61	62	5·11	10·06	10·23	5,720,660	12,107	37	59	22	3·05	4·87	1·81	1·32	4·86
1908	2,109,387	6,095	18	50	52	2·95	8·20	8·53	6,299,282	12,933	45	97	82	3·48	7·50	6·34	1·32	* 3·55
Totals and Averages..	17,451,200	46,036	424	378	331	9·21	8·21	7·19	47,312,161	98,657	264	493	218	2·67	4·99	2·21	1·295	3·48

* 20 per cent less production in this year.

STATEMENT showing the Number of Persons Employed, Fatal Accidents, and Ratio per 1,000 Men Employed, in the Mines of British Columbia, Ontario, Nova Scotia, and Quebec, and Comparative Statement with other Countries.

Provinces.	Year 1906.					Year 1907.					Year 1908.				
	Employed Under Ground.	Employed Above Ground.	Total Employed.	Number of Deaths.	Death Rate per 1,000 Employed.	Employed Under Ground.	Employed Above Ground.	Total Employed.	Number of Deaths.	Death Rate per 1,000 Employed.	Employed Under Ground.	Employed Above Ground.	Total Employed.	Number of Deaths.	Death Rate per 1,000 Employed.
British Columbia—															
Coal	3,415	1,390	4,805	15	3·12	4,389	1,670	6,059	31	5·12	4,432	1,641	6,073	18	2·95
Metal	2,535	1,183	3,718	17	4·57	2,585	1,112	3,697	20	5·41	2,448	1,089	3,537	21	5·93
Ontario—															
Copper-Nickel			2,227	4	2·45			1,824	4	2·10				15	
Silver and Iron			1,057	3	2·84			2,038	15	7·36	1,089	1,325		32	24·8
Nova Scotia—															
Coal	9,301	2,738	12,039	28	2·31	9,507	2,580	12,087	37	3·05	10,152	2,781	12,933	45	3·48
Metal				6	11·61				2	4·14			581		
Quebec					1·23					1·46					
United Kingdom—															
Coal	697,129	170,032	867,161	1,116	1·29	745,197	179,900	925,097	1,216	1·32	796,329	191,484	987,813	1,304	1·32
Metal	30,242	15,181	45,424	62	1·36	31,259	15,864	47,123	63	1·33	17,417	12,510	29,927	37	1·23
Germany—															
Coal			569,745	1,073	1·90			609,575	1,562	2·64					
Metal			89,764	88	0 98			82,680	110	1·33					
France—															
Coal	129,624	48,807	178,431	1,280	7·17	133,117	50,745	183,862	202	1·10					
Metal	14,709	5,937	20,646	51	2·47	16,305	7,892	24,197	55	2·27					
United States (4 states)—															
Coal			640,780	2,092	3·20			680,492	3,156	4·86			690,438	2,450	3·55
Metal			85,369	251	2·93			87,848	248	2·83					3·17

REPORTS, BULLETINS, MAPS, ETC., PUBLISHED IN 1909, BY THE MINES BRANCH.

Reports.

No.

20. Iron Ore Deposits of Nova Scotia (Part I). By Dr. J. E. Woodman.
22. On the Examination of some Iron Ore Deposits in the Districts of Thunder Bay and Rainy River, Ont. By F. Hille, M. E.
23. Iron Ore Deposits along the Ottawa (Quebec side) and Gatineau rivers. By Fritz Cirkel, M.E.
25. On the Tungsten Ores of Canada. By T. L. Walker, M.A., Ph. D.
26. Annual Report of the Mineral Production of Canada. 1906. By John McLeish, B.A.
27. Preliminary Report on the Mineral Production of Canada for the calendar year 1908. By John McLeish, B.A.
28. Summary Report of Mines Branch, 1908.
29. Chrome Iron Ores of the Eastern Townships. By Fritz Cirkel, M.E. (Supplementary Section: Experiments with Chromite at McGill University. By Dr. J. B. Porter).
30. Investigations of the Peat Bogs and Peat Fuel Industry of Canada, 1908. (Two editions). Bulletin No. 1. By Erik Nystrom, M.E., and A. Anrep, Peat Expert.
32. On the Investigation of an Electric Shaft Furnace, Domnarfvet, Sweden, etc. (Two editions). By Dr. Eugene Haanel.
31. The Production of Cement in Canada during the calendar year 1908. By John McLeish, B.A.
42. Production of Iron and Steel in Canada during the calendar years 1907 and 1908. By John McLeish, B.A.
43. Production of Chromite in Canada during the calendar years 1907 and 1908. By John McLeish, B.A.
44. Production of Asbestos in Canada during the calendar years 1907 and 1908. By John McLeish, B.A.
45. Production of Coal, Coke, and Peat in Canada during the calendar years 1907 and 1908. By John McLeish, B.A.
46. Production of Natural Gas and Petroleum in Canada during the calendar years 1907 and 1908. By John McLeish, B.A.
47. Iron Ore Deposits of Vancouver and Texada islands, B.C. By Einar Lindeman, M.E.
55. Bituminous or Oil-shales of New Brunswick and Nova Scotia; also on the Oil-shale Industry of Scotland, Part I. By R. W. Ells, LL.D., F.R.S.C.
62. Preliminary Report on the Mineral Production of Canada for the calendar year 1909. By John McLeish, B.A.

Schedule of Charges for Chemical Analyses and Assays:—

Maps.

33. Magnetometric Survey, Vertical Intensity: Lot 1, Concession VI, Mayo township, Hastings county, Ont. By Howells Fréchette, M.Sc.
34. Magnetometric Survey, Vertical Intensity: Lots 2 and 3, Concession VI, Mayo township, Hastings county, Ont. By Howells Fréchette, MSc.

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35. Magnetometric Survey, Vertical Intensity: Lots 10, 11, and 12, Concession IX, and Lots 11 and 12, Concession VIII, Mayo township, Hastings county, Ont. By Howells Fréchette, M.Sc.
36. Survey of Mer Bleue Peat Bog, Gloucester township, Carleton county, and Cumberland township, Russell county, Ont. By Erik Nystrom, M.E., and A. Anrep, Peat Expert.
37. Survey of Alfred Peat Bog, Alfred and Caledonia townships, Prescott county, Ont. By Erik Nystrom, M.E., and A. Anrep, Peat Expert.
38. Survey of Welland Peat Bog, Wainfleet and Humberstone townships, Welland county, Ont. By Erik Nystrom, M.E., and A. Anrep, Peat Expert.
39. Survey of Newington Peat Bog, Osnabruck, Roxborough, and Cornwall townships. Stormont county, Ont. By Erik Nystrom, M.E., and A. Anrep, Peat Expert.
40. Survey of Perth Peat Bog, Drummond township, Lanark county, Ont. By Erik Nystrom, M.E., and A. Anrep, Peat Expert.
41. Survey of Victoria Road Peat Bog, Bexley and Carden townships, Victoria county, Ont. By Erik Nystrom, M. E., and A. Anrep, Peat Expert.
48. Magnetometric Map of Iron Crown claim at Klaanch river, Vancouver island, B.C. By Einar Lindeman, M.E.
49. Magnetometric Map of Western Steel Iron claim, at Sechart, Vancouver island, B.C. By Einar Lindeman, M.E.
50. Vancouver island, B.C. By Einar Lindeman, M.E.
51. Iron Mines, Texada island, B.C. By F. H. Shephard, C.E.
52. Sketch Map of Bog Iron Ore Deposits, West Arm, Quatsino sound, Vancouver island, B.C. By L. Frank.
53. Iron Ore Occurrences, Ottawa and Pontiac counties, Que., 1908. By J. White and Fritz Cirkel, M.E.
54. Iron Ore Occurrences, Argenteuil county, Que., 1908. By Fritz Cirkel, M.E.
57. The Productive Chrome Iron Ore District of Quebec. By Fritz Cirkel, M.E.
60. Magnetometric Survey map of the Bristol Mine, Pontiac county, Que. By Einar Lindeman, M.E.
61. Topographic map of Bristol Mine, Pontiac county, Que. By Einar Lindeman, M.E.

ACCOUNTANT'S STATEMENT.

Statement of Appropriation and Expenditure by Mines Branch for year ended March 31, 1909:—

—	Appropriation.	Expenditure.
	$ cts.	$ cts.
Amount voted by Parliament	121,729 16	
Civil list salaries		26,929 14
Coal tests		18,486 29
Publication of reports and maps		15,259 35
Wages		11,975 68
Investigations *re* peat and coal		11,761 01
Travelling expenses		2,452 02
Fuel testing plant		2,371 50
Investigations *re* iron ores		1,890 48
Laboratory		1,536 80
Mining and metallurgical industries		1,309 98
Printing, stationery, and mapping materials		1,233 73
Investigations of oil-shales		823 84
Monograph on asbestos		662 09
" gypsum		409 55
Miscellaneous		323 48
Instruments		284 75
Books and periodicals		128 25
Balance unexpended and lapsed		24,381 22
		122,219 16
Less paid from appropriations 1907-8		490 00
	121,729 16	121,729 16

(Signed) JOHN MARSHALL,
Accountant, Department of Mines.

APPENDICES.

I. Mineral Production in Canada in 1909.

II. Description of Commercial Methods and Apparatus for the Analysis of Oil-shales.

III. U. S. Report on Mine Explosions: By Foreign Exports.

IV. On the Examination of Magnetic Iron Ores.

APPENDIX I.

PRELIMINARY REPORT ON THE MINERAL PRODUCTION OF CANADA, DURING THE CALENDAR YEAR 1909: WITH REVISED STATISTICS FOR 1908.

Letter of Transmittal.

EUGENE HAANEL, Ph.D.,
Director of Mines.

SIR,—I beg to submit herewith, the annual preliminary report on the mineral production of Canada in 1909, including a table showing the revised statistics of production in 1908.

The figures of production given for 1909 are, of necessity, subject to revision, since at this time, in many instances, producers of metallic ores have not themselves received complete returns from smelters. For these and other reasons, estimates have to be made. It is hoped, however, that this preliminary statement may serve to give a general idea of the gross output of the mineral industry during the year.

When more complete information is available, the annual report will be prepared. It will contain the final statistics in greater detail, as well as information relating to exploration, development, prices, markets, imports, exports, etc.

Special acknowledgments are due to the many mining operators and managers or owners of smelting establishments who have promptly furnished statements of their production.

I am, Sir, your obedient servant,

(Signed) JOHN McLEISH.

Division of Mineral Resources and Statistics.

SESSIONAL PAPER No. 26a

THE MINERAL PRODUCTION OF CANADA IN 1908.

(Revised.)

Product.		Quantity. (*a*)	Value. (*b*)
METALLIC.			$
Antimony ore (exports)	Tons.	148	5,443
Copper (*c*)	Lbs.	63,702,873	8,413,876
Gold	Ozs.	476,112	9,842,105
Pig iron from Canadian ore (*d*)	Tons.	99,420	1,664,302
Lead (*e*)	Lbs.	43,195,733	1,814,221
Nickel (*f*)	"	19,143,111	8,231,538
Cobalt			113,423
Silver (*g*)	Ozs.	22,106,233	11,686,239
Zinc ore	Tons.	452	3,215
Total			41,774,362
NON-METALLIC.			
Arsenic			58,566
Asbestos	Tons.	66,548	2,555,361
Asbestic	"	24,225	17,974
Calcium carbide	"	6,864	417,150
Chromite	"	7,225	82,008
Coal	"	10,886,311	25,194,573
Corundum	"	1,089	100,398
Feldspar	"	7,877	21,099
Graphite	"	251	5,565
" artificial	"	214	
Grindstones	"	3,843	48,128
Gypsum	"	340,964	575,701
Limestone for flux in iron furnaces	"	418,661	289,705
Magnesite	"	120	840
Mica	"	436	139,871
Mineral pigments—Barytes	"	4,312	19,021
" Ochres	"	4,746	30,440
Mineral water			151,953
Natural gas (*h*)			1,012.660
Peat	Tons.	60	180
Petroleum (*i*)	Bls.	527,987	747,102
Phosphate	Tons.	1,596	14,794
Pyrites	"	47,336	224,824
Quartz	"	44,741	52,830
Salt	"	79,975	378,798
Talc	"	1,016	3,048
Tripolite	"	30	195
Total			32,142,784

(*a*) Quantity of product sold or shipped.

(*b*) The metals, copper, lead, nickel, and silver are for statistical and comparative purposes valued at the final average value of the refined metal in New York. Pig iron is valued at the furnace and non-metallic products at the mine or point of shipment.

(*c*) Copper contents of ore, matte, etc., at 13·208 cents per pound.

(*d*) The total production of pig iron in Canada in 1908 was 630,835 short tons valued at $8,111,194, of which it is estimated about 99,420 tons valued at $1,664,302 should be attributed to Canadian ore and 531,415 tons valued at $6,446,892 to the ore imported.

(*e*) Lead contents of ore, matte, etc., at 4·200 cents per lb.

(*f*) Nickel contents of matte shipped at 43 cents per lb.

(*g*) Silver contents of ore, etc., at 52·864 cents per lb.

(*h*) Gross return from sale of gas.

(*i*) Deduced from the amount paid in bounties and valued at $1.41½ per barrel.

THE MINERAL PRODUCTION OF CANADA IN 1908—*Concluded.*

(Revised.)

Product.	Quantity. *(a)*	Value. *(b)*
STRUCTURAL MATERIAL AND CLAY PRODUCTS.		$
Cement, natural ..... Bls.	1,044	815
" Portland ..... "	2,665,289	3,709,139
Clay products—		
Bricks, common ..... No.	408,305,768	2,982,255
" pressed ..... "	53,480,764	517,180
" paving ..... "	3,719,961	59,456
" moulded and ornamental	.....	18,535
Fireclay and fireclay products	.....	110,302
Fireproofing and architectural terra-cotta	.....	170,211
Pottery	.....	200,541
Sewer pipe	.....	514,362
Tiles, drain ..... No.	20,100,261	298,561
Lime ..... Bus.	3,601,468	712,947
Stone—		
Building stone	.....	1,800,000
Flagstones ..... No.	61,200	6,293
Granite ..... Tons.	.....	282,320
Slate ..... Squares.	2,950	13,496
Sand-lime brick ..... No.	17,288,260	152,856
Sand and gravel (exports) ..... Tons.	298,954	161,387
Total, structural material, etc	.....	11,710,656
" all other non-metallic	.....	32,142,784
Total, non-metallic	.....	43,853,440
" metallic	.....	41,774,362
Estimated value of mineral products not reported	.....	300,000
Total value, 1908	.....	85,927,802

ANNUAL MINERAL PRODUCTION IN CANADA SINCE 1886.

1886	$10,221,255	1898	$38,412,431
1887	10,321,331	1899	49,234,005
1888	12,518,894	1900	64,420,983
1889	14,013,113	1901	65,804,611
1890	16,763,353	1902	63,211,634
1891	18,976,616	1903	61,740,513
1892	16,623,415	1904	60,073,897
1893	20,035,082	1905	69,525,170
1894	19,931,158	1906	79,057,308
1895	20,505,917	1907	86,865,202
1896	22,474,256	1908	85,927,802
1897	28,485,023		

SESSIONAL PAPER No. 26a

PRELIMINARY REPORT ON THE MINERAL PRODUCTION OF CANADA IN 1909.

(Subject to revision.)

Product.		Quantity. (*a*)	Value. (*b*)
METALLIC.			$
Copper (*c*)	Lbs.	54,061,106	7,018,213
Gold			9,790,000
Pig iron from Canadian ore (*d*)	Tons.	149,444	2,222,215
Iron ore (exports)	"	21,956	61,965
Lead (*e*)	Lbs.	45,857,424	1,959,488
Nickel (*f*)	"	26,282,991	9,461,877
Cobalt			* 66,319
Silver (*g*)	Ozs.	27,378,590	14,358,310
Zinc			250,000
Total value, metallic			45,188,387
NON-METALLIC.			
Arsenic	Tons.	1,129	64,100
Asbestos	"	63,349	2,284,587
Asbestic and asbestic sand	"	23,951	17,188
Chromite (exports)	"	1,794	20,858
Coal	"	10,411,955	24,431,351
Corundum	"	1,491	157,398
Feldspar	"	10,286	35,694
Graphite	"	730	37,624
Grindstones	"	3,965	50,944
Gypsum	"	468,551	667,816
Magnesite	"	330	2,508
Mica	"		154,106
Mineral pigments—			
Ochres and barytes	"	4,119	29,213
Mineral waters			177,304
Natural gas (*h*)			1,205,943
Petroleum (*i*)	Bls.	420,755	559,604
Phosphate (apatite)	Tons.	597	4,618
Pyrites	"	57,038	196,312
Quartz	"	50,541	63,032
Salt	"	84,037	415,219
Talc	"	4,506	12,172
Total value, non-metallic			30,587,591

(*a*) Quantity of product sold or shipped.

(*b*) The metals, copper, lead, nickel, and silver are for statistical and comparative purposes valued at the final average value of the refined metal in New York. Pig iron is valued at the furnace and non-metallic products at the mine or point of shipment.

(*c*) Copper contents of smelter products and ores exported, at 12·982 cents per pound.

(*d*) The total production of pig iron in Canada in 1909 was 757,162 tons valued at $9,581,864, of which it is estimated 607,718 tons valued at $7,359,649 should be credited to imported ores.

(*e*) Refined lead and lead contained in base bullion exported at 4·273 cents per pound.

(*f*) Nickel contents of matte produced, at 36 cents per pound (the lowest quotation for nickel in New York less 10 per cent). The value of the nickel contained in the matte was, as returned by the operators, $2,810,748, or an average per pound of 10·7 cents.

(*g*) Estimated recoverable silver at 51·503 cents per ounce.

(*h*) Gross returns for sale of gas.

(*i*) Quantity on which bounty was paid and valued at $1.33 per barrel.

* Additional returns increase this item to $90,950.

PRELIMINARY REPORT ON THE MINERAL PRODUCTION OF CANADA IN 1909—(*Concluded.*)

(Subject to revision.)

Product.	Quantity. (*a*)	Value. (*b*)
STRUCTURAL MATERIAL AND CLAY PRODUCTS.		$
Cement, Portland ..... Bls.	4,010,180	5,266,008
Clay products—		
Brick		4,200,000
Sewer pipe, fireclay, drain tile, etc		1,300,000
Lime ..... Bus.	5,163,874	1,049,473
Sand and gravel (exports) ..... Tons.	481,584	256,166
Stone—		
Granite		340,047
Limestone for flux in blast furnaces		328,091
Marble, limestone, and sandstone		1,600,000
Total structural material and clay products		14,339,785
All other non-metallic		30,587,591
Total value, non-metallic		44,927,376
Total value, metallic		45,188,387
Estimated value of mineral products not reported		300,000
Total value, 1909		90,415,763

REMARKS.

The preliminary table of mineral production in Canada given herewith, shows the total value of the production in 1909 to have been in excess of $90,000,000. Compared with the total value for 1908, which was $85,927,802, the production of 1909 shows an increase of a little over 5 per cent. The actual increase or betterment in the mining industry in 1909 was, however, somewhat greater than is indicated by this comparison. Owing to a slight change in the method of compiling statistics of the quantities of metals produced, the values for 1909 are somewhat less than they would otherwise have been.

Of the total production in 1909, $45,188,387—or 49·9 per cent of the total—is credited to the metals, and $44,927,376—or 49·7 per cent—to non-metallic products; a small allowance being made for mineral products not reported. Amongst the individual products coal is still the most important, its value constituting 27 per cent of the total; silver occupies second place with 15·9 per cent; gold and nickel come next with 10·8 and 10·5 per cent respectively; copper contributes 7·8 per cent; cement 5·8 per cent; clay products 6·1 per cent; asbestos 2·5 per cent.

The metals nearly all showed an increased output compared with 1908. The average prices remained fairly steady throughout the year, differing but slightly from those of the year before; copper, nickel, and silver, being lower in price; while lead, spelter, and tin, were higher.

A comparison of New York average monthly prices is shown herewith.

Average monthly prices of metals, 1906-9.

—	1906.	1907.	1908.	1909.
	Cts.	Cts.	Cts.	Cts.
Copper	19·278	20·004	13·208	12·982
Lead	5·657	5·325	4·200	4·273
Nickel	41·64	45·000	43·000	40·000
Silver	66·791	65·327	52·864	51·503
Spelter	6·198	5·962	4·720	5·503
Tin	39·819	38·166	29·465	29·725

In the non-metallic class there is a larger number of products showing increases than those showing decreases. The coal production was seriously reduced by the labour troubles in Nova Scotia. The asbestos shipments were somewhat less, and petroleum production shows a considerable falling off. In nearly all of the other items, however, there were important increases: particularly in corundum, gypsum, natural gas, salt, and in the structural materials, cement, clay products, lime and stone.

SMELTER PRODUCTION.

General statistics of smelter production were collected by this Branch for the first time in 1908, and the aggregate results of these operations during the past two years are shown in the accompanying table. It should be explained, also, that the figures include the results of the treatment of a small quantity of imported ores. The results of the operations at the smelter at Northport, Wash.,—treating chiefly Canadian ores—have been included.

Smelter and Refinery Production in Canada, 1908 and 1909.

—		1908.		1909.	
		Refined Products.	Metals contained in matte, blister, base bullion, and speiss exported.	Refined Products.	Metals contained in matte, blister, base bullion, and speiss exported.
Gold	Ozs.	15,436	203,300	18,241	200,129
Silver	"	11,168,689	3,271,899	14,242,545	4,845,920
Lead	Lbs.	36,549,274	1,116,792	41,883,614	3,973,810
Copper	"	.....	51,965,289	.....	53,328,583
Copper sulphate	"	203,379	.....	51,405	.....
Nickel	"	.....	19,506,251	.....	27,041,857
Cobalt	"	.....	692,170	.....	1,721,083
White arsenic	"	1,431,052	.....	2,258,087	.....
Arsenic	"	.....	436,787	.....	1,074,516

The total ore charged to the furnaces in 1909 was 2,377,780 tons, of which slightly over 40,000 tons were imported. The smelter products exported for refining included, in 1908, copper matte, 7,649 tons; blister copper, 15,418 tons; Bessemer nickel-copper matte, 21,210 tons, and silver-cobalt-nickel speiss, 1,326 tons. In 1909 these smelter products were: base bullion, 2,010 tons; copper matte, 11,597 tons; blister copper, 14,239 tons; Bessemer nickel-copper matte, 25,845 tons; silver-cobalt-nickel speiss, 2,660 tons.

Gold.—A preliminary estimate shows a slight decrease in gold production in 1909. The total production in 1908 was $9,842,105, to which the Yukon district contributed $3,600,000; British Columbia, $5,929,880; Nova Scotia, $244,799. In 1909 the Yukon shows a further increase, the value of the gold being estimated at $3,960,000. The total gold exports on which royalty was paid were, according to the records of the Interior Department, during the calendar year, 239,766·35 ounces.

Complete statistics are not yet available as to the gold production in British Columbia, but the returns received appear to indicate a reduced output. The production in Nova Scotia will not differ much from that of the previous year.

Silver.—The rapid growth of Canada's silver production which has taken place during the past few years continued during 1909. Increased production is reported from both British Columbia and Ontario. In the first-mentioned Province the silver is recovered with the lead from the galena ores of that Province, of which there was an increased production in 1909. The metal also constitutes an important value in the gold-copper-silver ores smelted.

In British Columbia, silver is recovered as fine metal at Trail and is contained in the matte and blister exported. In Ontario, where the production is practically all from the Cobalt district, a portion of the ores (8,384 tons in 1909) is treated in Canadian metallurgical works producing silver bullion, white arsenic, and a speiss containing silver, cobalt, nickel, etc.; the balance of the ore being exported for treatment abroad. The total production of recoverable silver in Canada is estimated at 27,878,590 ounces valued at $14,358,310, the average price of silver for the year being 51·503 cents.

The price of refined silver varied between a maximum of 53⅞ cents per ounce on May 5, and a minimum of 50¼ cents on March 3.

The production from the Cobalt district again shows a considerable increase over the previous year, but not so large an advance as was made in 1908 over 1907. According to returns received from 31 shipping mines, there were shipped during 1909 about 28,042 tons of ore and 2,967 tons of concentrates, a total tonnage of 31,009. The silver content of ore shipped is returned as 23,581,788 ounces, or an average of 805·284 ounces per ton; and for the concentrates shipped 3,639,475 ounces, or an average of 1,226·651 ounces per ton. Bullion shipped from the mines contained 143,440 fine ounces of silver.

The total silver content of ore, concentrates, and bullion shipped from the mines was 26,364,703 ounces. The mine owners receive payment for only 93 to 98 per cent of the silver content; and in valuing the production a deduction of 5 per cent is made from silver contained in ore and concentrates to cover losses in smelting and refining. On this basis the silver recovery is estimated at 25,128,590 ounces, and valued at $12,941,978. Payments for cobalt content were reported as $90,750; the total value of the year's output was a little over $13,000,000, without deductions for freight and treatment charges.

The number of men employed in shipping mines was reported as 2,768, and wages paid $2,396,742. Incomplete returns of concentration showed 127,271 tons of ore treated, producing 3,213 tons of concentrates.

In 1908 the shipments were 25,682 tons of ore and concentrates containing 19,398,545 ounces of silver, or an average of 755 ounces per ton.

The exports of silver in 1909, for the whole of Canada, as reported by the Customs Department, were 31,126,504 ounces valued at $15,719,909.

Copper.—Although refined copper is not produced in Canada, the copper ores are mostly reduced to matte or blister copper carrying additional values in the precious and other metals. Some copper pyrites ore is mined in Quebec province, from which the copper is recovered after the ore has been used as a source of sulphur, and a

small quantity of copper ore is exported from British Columbia coast mines to United States smelters for treatment.

Statistics are not available at the present time to show the total quantity of copper contained in ores shipped from the mines. The total production of copper, however, contained in blister and matte produced and estimated as recoverable from ores exported, was in 1909 approximately 54,061,106 pounds. In 1908 the production of copper, estimated on the same basis, was 52,928,386 pounds, an increased production of about 2 per cent being, therefore, shown in 1909.

Of the production in 1909, Ontario is credited with 15,746,699 pounds and British Columbia wth 37,314,407 pounds. The latter figure may be subject to more or less variation as complete returns had not been received of all ore exported.

The New York price of electrolytic copper varied between the limits of 12 cents and 14⅝ cents per pound, the average monthly price being 12·982 cents, as compared with an average monthly price of 13·208 cents in 1908.

The total exports of copper contained in ore matte and blister, according to Customs Department returns, were 54,447,750 pounds, valued at $5,832,246.

Lead.—The total production in 1909 of pig and manufactured lead, and lead contained in base bullion exported was 45,857,424 pounds, valued, at the average price of refined lead in New York, at $1,959,488.

It is possible that there was also some lead ore or lead concentrates exported, of which no record has yet been received. Customs Department statistics indicate such an export of upwards of 2,000,000 pounds.

The production of refined lead, and lead contained in base bullion exported in 1908, was 37,666,066.

Customs Department statistics in this year also indicate an export of lead ore or concentrates, and the total production in 1908 of lead available for consumption was estimated at 40,891,448 pounds; an increased production in 1909 is, therefore, shown of from 5,000,000 to 7,000,000 pounds. This production in both years was all from the Province of British Columbia..

The total amount of bounty paid during the twelve months ending December 31, 1909, on account of lead production was $346,527.98.

The exports of lead in ore, concentrates, base bullion, etc., during the year were 3,116 tons, and of pig lead 5,650 tons, or a total of 8,766 tons. From 14,000 tons to 15,000 tons of domestic production were, therefore, available for home consumption.

The price of lead in New York during 1909 averaged 4·273 cents per pound, varying between 3·95 cents in March and 4·70 cents in December. In 1908 the average was 4·200 cents per pound. The London price per long ton varied between £12 10s. and £13 16s., averaging £13·049.

Nickel.—The nickel industry was particularly active during 1909, the largest production on record being shown. Although important quantities of nickel are contained in the cobalt silver ores of Coleman township, the Sudbury district continues to be the chief source of nickel production. The same companies are carrying on active operations: the Mond Nickel Company, at Victoria mines, and the Canadian Copper Company, at Copper Cliff. The ore is first roasted and then smelted to a Bessemer matte containing from 77 to 82 per cent of the combined metals, copper and nickel; the matte being shipped to the United States and Great Britain for refining.

The total production of matte in 1909 was 25,845 tons, valued at the furnaces at $3,913,012. The metallic contents were: copper, 15,746,699 pounds; nickel 26,282,991 pounds.

The aggregate results of the operations on the Sudbury District nickel-copper ores during the past four years are as follows:—

	1906. Tons of 2,000 lbs.	1907. Tons of 2,000 lbs.	1908. Tons of 2,000 lbs.	1909. Tons of 2,000 lbs.
Ore mined	343,814	351,916	409,551	451,892
Ore smelted	340,059	359,076	360,180	462,336
Bessemer matte produced	20,364	22,041	21,197	25,845
" shipped	20,310	22,025	21,210	.....
Copper contents of matte shipped	5,265	6,996	7,503	7,873
Nickel " " "	10,745	10,595	9,572	13,141
Spot value of matte shipped	$4,628,011	$3,289,382	$2,930,989	$3,913,012
Wages paid	1,117,420	1,278,694	1,286,265	1,234,904
Men employed	1,417	1,660	1,690	1,735

Exports of nickel contained in ore, matte, etc., as compiled from Customs reports, were for the twelve months ending December 31, as follows:—

	1906. Pounds.	1907. Pounds.	1908. Pounds.	1909. Pounds.
To Great Britain	2,716,892	2,518,338	2,554,486	3,843,763
To United States	17,936,953	16,857,997	16,865,407	21,772,635
	20,653,845	19,376,335	19,419,893	25,616,398

Nickel contained in silver cobalt ores:—The mine owners received no payment for nickel content and complete statistics are not available as to the total quantity of nickel contained in these ores, of which about 31,009 tons were shipped during 1909. Of the total shipments, 8,384 tons were treated in Canadian metallurgical works at Copper Cliff, Deloro, and Thorold, producing silver bullion and white arsenic; the remaining speiss or residues amounted to 2,660 tons and contained silver, cobalt, nickel, and arsenic, the nickel content totalling 758,966 pounds and the cobalt content, 1,721,083 pounds.

The price of refined nickel in New York was quoted at from 40 to 50 cents per pound, the quotations in December being 'large lots, contract business 40 to 45 cents per pound; retail spot from 50 cents for 2,000 pound lots up to 55 cents for 500 pound lots. The price for electrolytic is 5 cents higher.'

Nickel is quoted on the London market at prices equivalent to, or slightly in excess of those in New York.

Iron Ore.—The total shipments of iron ore from mines in Canada in 1909 were 268,043 short tons, valued at $659,120; as compared with 238,082 tons valued at $568,189 in 1908. The shipments in 1909 may be classified as: magnetites 73,420 tons; hematite 190,473 tons; bog ore 3,330 tons; titaniferous magnetite (sand) for experimental purposes 820 tons. In 1898 the ores shipped included magnetite 49,946 tons; hematite 173,164 tons; carbonate ore 4,869 tons; bog ore 10,103 tons.

Exports of ore from Canada during 1909, as recorded by the Customs Department, were 21,956 tons, valued at $61,965.

Although not a portion of the Dominion of Canada, it may be of interest to state the iron ore shipments from Newfoundland during 1909. The two Canadian com-

panies operating the Wabana mines shipped during the year 991,115 gross tons, or 1,110,049 short tons, of which 697,068 tons were shipped to Sydney and 412,981 tons to the United States and Europe.

Pig Iron.—An increase of 20 per cent is shown in the production of pig iron in Canada in 1909 as compared with 1908, despite the fact that the Londonderry furnace was out of commission during the whole year. The total production during 1909 was 757,162 short tons, valued at $9,581,864; as compared with 630,835 tons, valued at $8,111,194, in 1908. These figures do not include the output from electric furnace plants, making ferro products, which are situated at Welland and Sault Ste. Marie, Ont., and Buckingham, Que.

Of the total output of pig iron during 1909, 17,003 tons valued at $371,368, or $21.84 per ton, were made with charcoal as fuel, and 740,159 tons valued at $9,210,496, or $12.44 per ton, with coke. The amount of charcoal iron made in 1908 was 6,709 tons, and iron made with coke, 624,126 tons. The classification of the production in 1909, according to the purpose for which it was intended, was as follows: Bessemer, 222,931 tons; basic, 400,921 tons; foundry, including miscellaneous, 116,307 tons.

The amount of Canadian ore used during 1909 was 231,994 tons, imported ore 1,234,990 tons; mill cinder, etc., 25,508 tons. The amount of coke used during the year was 919,271 tons, comprising 412,016 tons from Canadian coal, and 507,255 tons imported coke or coke made from imported coal. The consumption of charcoal was 1,782,258 bushels. Limestone flux was used to the extent of 526,076 tons. In connexion with blast furnace operations there were employed 1,486 men, and $879,426, paid in wages.

The total capacity of 16 completed furnaces was, according to returns received, 2,735 tons. The number of furnaces in blast on December 31, 1909, was 11.

The production of pig iron by provinces in 1908 and 1909 was as follows:—

Province.	1908.			1909.		
	Tons.	Value.	Per ton.	Tons.	Value.	Per ton.
		$	$ cts.		$	$ cts.
Nova Scotia	352,642	3,554,540	10 08	345,380	3,453,800	10 00
Quebec	6,709	171,383	25 55	4,770	125,623	26 34
Ontario	271,484	4,385,271	16 15	407,012	6,002,441	14 75
Total	630,835	8,111,194	12 86	757,162	9,581,864	12 65

Steel.—Returns were received from eight steel plants, at which 2,073 men were employed and $1,284,940 paid in wages during 1909. The total production of ingots and castings was 754,719 short tons, with an estimated value of $14,359,710; as compared with 588,763 tons, valued at $10,916,602, in 1908.

Details of production during the two years are as follows:—

	1908.		1909.	
	Tons.	$	Tons.	$
Ingots—Open-hearth (basic)	443,442	7,684,277	535,988	9,372,615
Bessemer (acid)	135,557	2,535,287	203,715	3,829,012
Castings—Open-hearth	9,051	617,126	14,013	1,043,370
Other steels	713	79,912	1,003	114,713
Total	588,763	10,916,602	754,719	14,359,710

Iron and Steel Bounties.—Following is a statement of the bounties paid on iron and steel during the calendar years 1908 and 1909, as kindly furnished by the Trade and Commerce Department. As no bounty is paid on iron made from mill cinder or ingredients other than ore, the figures do not show the total output of the furnaces, but only those quantities on which bounty was paid.

	1908.		1909.	
	Quantity on which Bounty was paid.	Bounty.	Quantity on which Bounty was paid.	Bounty.
	Tons.	$ cts.	Tons.	$ cts.
Pig iron made from Canadian ore	101,647	213,458 34	126,297·55	214,705 80
Pig iron made from imported ore	517,427	569,166 93	607.718·09	425,402 64
Total, pig iron	619,074	782,628 27	734.015·64	640,108 44
Steel ingots	556,289	917,876 63	729,189·37	766,470 41
Steel wire rods	49,630	297,778 68	81,405·42	488,432 70
Total bounty paid on iron and steel		1,998,283 58		1,895,011 55

White Arsenic.—The total output of white arsenic as reported by three firms making this product was 2,258,187 pounds valued at $64,100. In addition, the residues or speiss from these works exported contained 1,074,511 pounds of arsenic. This is all obtained from that portion of the Cobalt ores treated in Canada. No record is available of the total arsenical content of these ores. The exports of arsenic are reported as 3,111,249 pounds valued at $119,673. The production of white arsenic in 1908 was 1,431,000 pounds valued at $41,060, and the arsenical ore and concentrates 986 tons valued at $17,506.

Asbestos.—A feature of special interest in connexion with the asbestos industry during 1909 has been the consolidation of interests amongst a number of the larger producers, resulting in the formation of the Amalgamated Asbestos Corporation, Ltd.

While the actual shipments of asbestos were somewhat less in 1909 than in 1908, the stocks on hand at the end of the year are reported considerably larger than on December 31, 1908.

The total shipments of crude and mill stock in 1909 were 63,349 tons valued at $2,284,587, as compared with shipments of 66,548 tons valued at $2,555,361 in 1908; the decrease being 3,199 tons, or 4·8 per cent. The stocks os hand December 31, 1909, were about 20,920 tons, valued approximately at $1,179,679, as compared with stocks on hand December 31, 1908, of 8,669 tons valued at $596,095.

The total shipments, showing details of crude and mill stock, were in 1908 and 1909, as follows:—

	1908.			1909.		
	Short Tons.	Value.	Per ton.	Short Tons.	Value.	Per ton.
		$	$ cts.		$	$ cts.
Crude, No. 1	857½	257,752	300 59	912·3	246,655	270 37
" 2	2,488	411,480	165 38	2,162	328,855	152 11
Mill Stock, No. 1	5,282⅔	425,448	80 54	14,776	785,731	53 18
" 2	45,545¾	1,345,750	29 33	32,417	800,728	24 70
" 3.	12,374¼	114,931	9 29	13,082	122,618	9 37
Total asbestos	66,548	2,555,561	38 40	63,349·3	2,284,587	36 06
Total asbestic	24,225	17,974	0 74	23,951	17,188	0 72
Grand total	90,773	2,573,335	.....	87,300·3	2,301,775	.....

Exports of asbestos according to Customs returns were:—

	Tons.	Value.
		$
Twelve months ending December, 1907	56,753	1,669,299
" " " 1908	61,210	1,842,763
" " " 1909	56,971	1,729,857

Corundum.—The quantity of corundum ore treated during the year was 35,894 tons, from which was produced 1,579 tons of grain corundum. The total shipments were 1,491 tons valued at $157,398, or an average of a little over 5 cents per pound.

Coal and Coke.—The total coal production in Canada in 1909, comprising sales and shipments, colliery consumption and coal used in making coke, is estimated at 10,411,955 short tons, valued at $24,431,351. This is a smaller production than in either of the two preceding years, though the total may be slightly increased when more complete returns are received. The western provinces each show an increased production of coal in 1909, but not sufficient to counteract the reduced output in Nova Scotia, which resulted from the coal miners' strike. The aggregate decrease for the whole of Canada was about 474,356 tons, or 4·36 per cent; while Nova Scotia alone showed a falling off of 968,789 short tons, or 14·56 per cent: the aggregate increase in the western provinces being 505,404 tons, or 12·11 per cent.

Of the total production Nova Scotia contributed 54·5 per cent, Saskatchewan and Alberta 20·5 per cent, and British Columbia 24·3 per cent.

The production by provinces was approximately as follows, the figures for 1907 and 1908 being also given:—

Province.	1907.		1908.		1909.	
	Tons.	Value.	Tons.	Value.	Tons.	Value.
		$		$		$
Nova Scotia	6,354,133	12,764,999	6,652,539	13,364,476	5,683,750	11,418,249
British Columbia	2,364,898	7,390,306	2,333,708	7,292,838	2,538,004	7,931,263
Alberta	1,591,579	3,836,286	1,685,661	4,127,311	1,978,843	4,730,270
Saskatchewan	151,232	252,437	150,556	253,790	163,329	253,073
New Brunswick	34,584	77,814	60,000	135,000	49,029	98,496
Yukon Territory	15,000	60,000	3,847	21,158	.....	.....
Totals	10,511,426	24,381,842	10,886,311	25,194,573	10,411,955	24,431,351

The total production of oven coke in 1909 was about 875,080 short tons, valued at $3,557,147, being a slight increase over the production in 1908. At the ovens of the Dominion Iron and Steel Co. at Sydney a quantity of imported coal was used, the supply of domestic coal being insufficient on account of the strike. The Atikokan Iron Company at Port Arthur uses imported coal exclusively. At all other ovens Canadian coal is used. At the end of the year there were in Nova Scotia 670 ovens in operation, 64 idle, and 120 building. In Alberta 226 were in operation and 40 idle, and in British Columbia 767 in operation and 753 idle. The ovens of the Dominion Iron and Steel Co. are of the Otto Hoffman by-product type, and there were recovered as by-products 4,016,834 gallons of tar and 3,351 short tons of sulphate of ammonia.

Feldspar.—Total shipments are reported as 10,286 tons valued at $35,694. This includes a quantity of high grade "dental spar" shipped from the Villeneuve mine, Quebec, and valued at from $16 to $20 per ton at Buckingham.

Petroleum and Natural Gas.—The production of crude petroleum was as usual nearly all derived from the Ontario peninsula. Direct returns from the producers have not been obtained, but the production upon which bounty was paid, ascertained by the Trade and Commerce Department, was 14,726,433 gallons, of which 3,328 gallons were produced in New Brunswick. This is equivalent to 420,755 barrels, and at an average price of $1.33 per barrel was valued at $559,604. The production in 1908 was 527,987 barrels valued at $747,102, an average per barrel of $1.34, showing a decrease of about 20 per cent in the quantity produced. The total bounty paid in 1909 was $220.896.50, as compared with $277,193.21 in 1908 and $414,157.89 in 1907.

While the production of petroleum has been falling off the receipts from natural gas sold have been increasing. The producing gas wells are located in the counties of Welland, Haldimand, Norfolk, Kent, Essex, and Bruce, in Ontario, and at Medicine Hat and vicinity in Alberta. The total receipts from gas sold in 1909 were about $1,205,943, the figures representing, with one or two exceptions, the total values paid by the consumers.

The quantity of gas sold or used during the year was over 6,000,000 M. feet. Of the total value about 95 per cent is to be credited to Ontario. The total receipts in 1908 were $1,012,660.

Phosphate.—The price of this mineral has been increasing. There is a growing demand for it and a revival of phosphate mining appears to be imminent.

Salt.—Complete returns of salt production received show total sales of 84,037 tons, valued at $415,219 for the salt alone. Packages used were valued at $175,612; stock on hand at the end of the year was reported as 2,671 tons; 185 men were employed, and $96,116 paid in wages.

Lime.—Fairly complete statistics of lime production have been received for 1909. The total sales and shipments are reported as 5,163,874 bushels valued at $1,049,473, or by provinces as follows: Nova Scotia and New Brunswick, 747,696 bushels, valued at $179,380; Quebec, 1,155,167 bushels, valued at $227,253; Ontario, 2,434,686 bushels, valued at $404,782; western provinces, 826,325 bushels, valued at $188,058.

Portland Cement.—Complete statistics have been received from all but two cement manufacturers in 1909. These, however, will not increase the totals by more than 2 or 3 per cent. Subject to this correction the total quantity of cement made during the year was 4,089,191 barrels, as compared with 3,495,961 barrels in 1908, an increase of 593,230 barrels, or 17 per cent.

The total quantity of Canadian Portland cement sold during the year was 4,010,180 barrels, as compared with 2,665,289 barrels in 1908, an increase of 1,344,891 barrels, or 50 per cent.

The total consumption of Portland cement in 1909, including Canadian and imported cement, was 4,152,374 barrels, as compared with 3,134,338 barrels in 1908, an increase of 1,018,036 barrels, or 32 per cent.

Detailed statistics of production during the past three years have been as follows:—

	1907.	1908.	1909.
	Barrels.	Barrels.	Barrels.
Portland cement sold	2,436,093	2,665,289	4,010,180
" manufactured	2,491,513	3,495,961	4,089,191
Stock on hand January 1	299,015	383,349	1,093,493
" December 31	354,435	1,214,011	1,172,504
Value of cement sold	$3,777,328	$3,709,063	$5,266,008
Wages paid	956,080	1,274,638	1,182,099
Men employed	1,786	3,029	2,411

The average price per barrel at the works in 1909 was $1.31, as compared with $1.39 in 1908.

The imports of Portland cement into Canada during the twelve months ending December 31, 1909, were 497,678 cwt., valued at $166,669. This is equivalent to 142,194 barrels of 350 pounds, at an average price per barrel of $1.17. The imports in 1908 were 469,049 barrels, valued at $531,045, or an average price per barrel of $1.13. The duty is 12½ cents per hundred pounds.

As there is very little cement exported from Canada, the consumption is practically represented by the Canadian sales together with the imports.

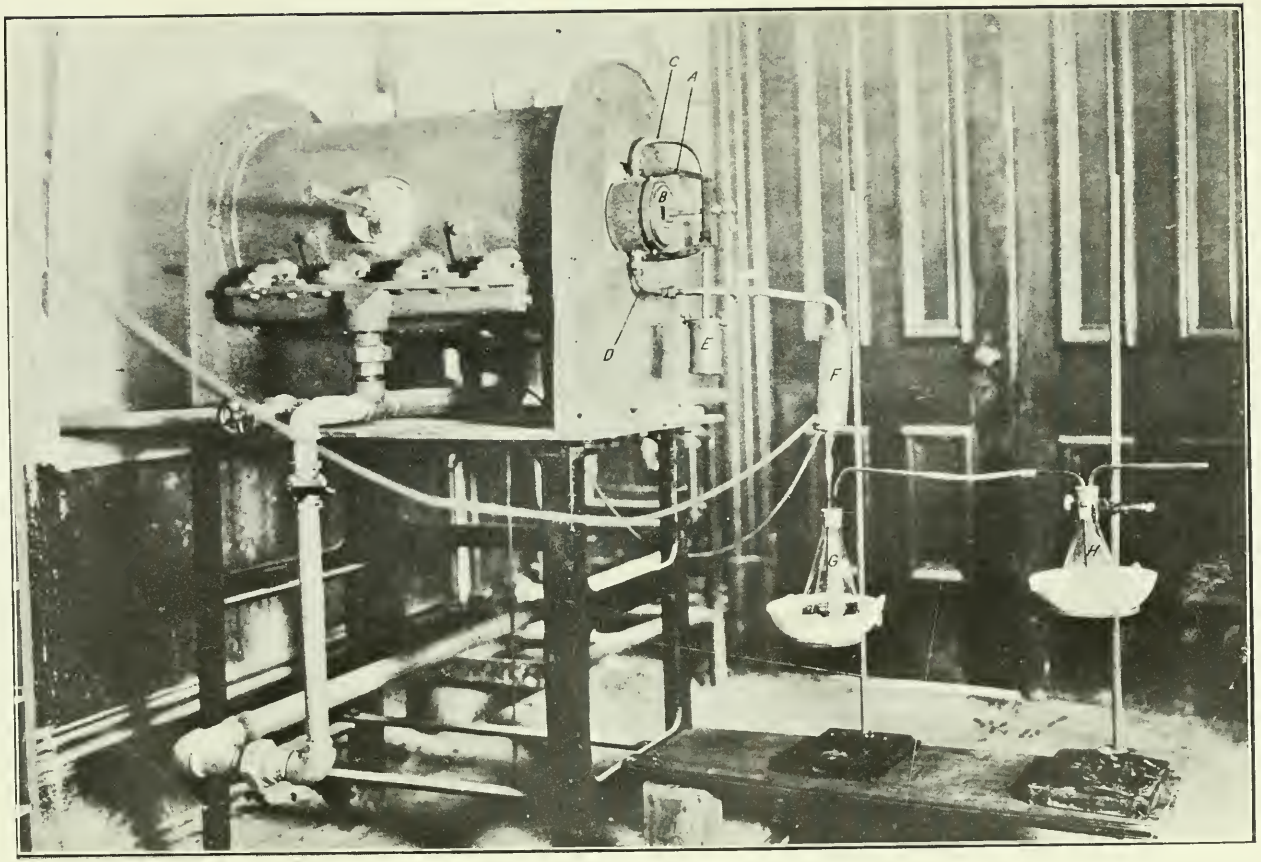
Following is an estimate of the Canadian consumption of Portland cement for the past five years:—

Calendar Years.	Canadian.		Imported.		Total.	
	Barrels.	Per cent.	Barrels.	Per cent.	Barrels.	Per cent.
1905	1,346,548	59	918,701	41	2,285,249	
1906	2,119,764	76	665,845	24	2,785,609	
1907	2,436,093	78	672,630	22	3,108,723	
1908	2,665,289	85	469,049	15	3,134,338	
1909	4,010,180	97	142,194	3	4,152,374	

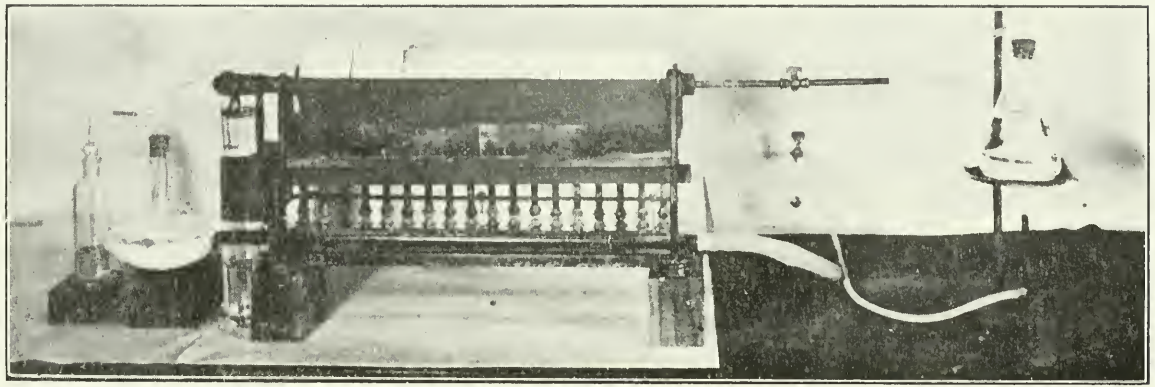
Exports of the Product of the Mine, Year 1909.

(Compiled from Trade and Navigation Monthly Statements.)

Products.		Quantity.	Value.
			$
Arsenic	Lbs.	3,111,249	119,673
Asbestos	Tons.	56,971	1,729,857
Chromite	"	1,794	20,858
Coal	"	1,588,099	4,456,342
Feldspar	"	10,834	35,234
Gold			5,629,551
Gypsum	Tons.	315,201	372,286
Copper, fine in ore, etc	Lbs.	54,447,750	5,832,246
Lead, in ore, etc	"	6,226,068	132,578
" pig, etc	"	11,301,960	361,064
Nickel, in ore, etc	"	25,616,398	2,676,483
Silver, in ore, etc	Ozs.	31,126,504	15,719,909
Platinum, in ore concentrates, etc	"	466	2,118
Mica	Lbs.	717,066	256,834
Mineral pigments	"	1,316,514	7,956
Mineral water	Gals.	60,562	7,433
Oil, refined	"	7,768	934
Ores—			
Antimony	Tons.	4	120
Iron	"	21,956	61,954
Manganese	"	3	434
Other ores	"	17,939	625,142
Phosphate	"	895	15,735
Plumbago	Cwt.	20,070	52,440
Pyrites	Tons.	35,798	156,644
Salt	Lbs.	276,765	2,488
Sand and gravel	Tons.	481,584	256,166
Slate	"	134	612
Stone, ornamental	"	1,027	8,606
" building, etc	"	26,672	15,481
" for manufacture of grindstones	"	125	1,685
Other products of the mine		.....	109,350
Manufactures—			
Bricks	M.	365	2,255
Aluminium, in bars, etc	Cwt.	61,345	918,195
" manufactures, etc		.....	3,453
Cement		.....	113,362
Clay, manufactures of		.....	979
Coke	Tons.	74,067	329,051
Grindstones, manufactured		.....	13,942
Gypsum, ground		.....	2,787
Iron and steel—			
Stoves	No.	744	10,330
Castings, N.E.S		.....	25,038
Pig iron	Tons.	5,063	186,978
Machinery (linotype machines)		.....	43,686
Machinery, N.E.S		.....	421,707
Sewing machines	No.	12,759	147,402
Typewriters	"	3,749	238,167
Scrap iron and steel	Cwt.	410,506	305,256
Hardware, tools, etc		.....	52,207
" N.E.S		.....	35,507
Steel and manufactures of		.....	1,132,678
Lime		.....	48,821
Metals, N.O.P		.....	134,062
Plumbago, manufactures of		.....	864
Stone, ornamental		.....	33,097
" building		.....	501



Apparatus for the determination of crude oil.



Apparatus for the Determination of Ammonium Sulphate.

APPENDIX II.

DESCRIPTION OF COMMERCIAL METHODS AND APPARATUS FOR THE ANALYSIS OF OIL-SHALES

BY

Harold Leverin, Ch.E.

The commercial value of oil-shales depends chiefly on the amount of crude oil and ammonium sulphate—per ton of shale—obtainable therefrom. With a view to providing for the accurate determination of the amount of these products in Canadian oil-shales, methods have been adopted which have been carefully checked, and are found to be in accord with the latest, improved, manufacturing methods. The following is a brief description of the methods adopted and apparatus installed in the chemical laboratory of the Mines Branch, Department of Mines, Ottawa, for the distillation, etc., of oil-shales.

DETERMINATION OF CRUDE OIL.

Hitherto, the nature of the carbonaceous matter in oil-shale has not been determined; but it can be affirmed with certainty that, it does not exist in the shale in the same condition as the substances obtained by destructive distillation of the shale; since none of these substances can be extracted by solvents, such as petrolic ether, benzine, etc.; but are formed by destructive distillation.

The apparatus for this determination (Plate I) consists of a malleable iron tube, 2¼″ inside diameter × 36″ long, closed at one end with an iron cap, and at the other by a disc B, secured by means of a clamp A, and packed with a lead washer in order to seal the retort perfectly. The retort is inclined at a convenient angle to enable the oil to run off. The oils, in both gaseous and liquid state, pass through tubes C and D; the oils already condensed being collected in the copper receptacle E. The others pass through condenser F into flask G, which is connected to flask H. Both the flasks are immersed in ice water. Generally, two-thirds of the distilled oils are received in receptacle E; the remainder in flask G; except a few drops, occasionally, in flask H. The retort is heated in a gas tube furnace of the American Gas Furnace Company's make.

The process of destructive distillation (Plate II) is comparatively simple. One pound of shale crushed into pieces ½″ square is placed in the retort, and heated gradually to a dull red heat, great care being exercised not to raise the temperature too suddenly, or higher than a dull red heat, otherwise considerable losses will occur. At lower temperatures the hydrocarbons of the fatty series are evolved; but at higher, those of the aromatic. When the temperature is too high, a white smoke is readily noticed in the glass flask; so that it is comparatively easy to keep the right temperature in the retort. The time generally required for distillation is 2½ hours, after which the oil obtained is cooled, separated from water, measured, and its specific gravity determined.

When the chemist has not at his disposal the apparatus described above, the following simple, and cheaper arrangement may be used instead:—

The tube used is made of a ½ inch wrought-iron tubing, 2" inside diameter × 6'-0" long. The tube is sealed at one end by an iron cap; the other end remaining open. No condenser is used; but the oil is collected as it runs out of the tube. The method of procedure is the same as already mentioned.

Although this method is used extensively in Scotch oil-shale works, and is suitable for most practical purposes, it is capable of giving only approximate results; as the lighter oils and naphtha are lost, and cannot be collected except by passing them through a condenser.

DETERMINATION OF AMMONIUM SULPHATE.

The method of analysis adopted for the determination of ammonium sulphate obtainable from oil-shale is known as the Bailey method. This method has been checked against the manufacturing process in which the 'Pumpherston' retort is used, and gives like results; but as improvements are made in manufacturing, this method of analysis will have to be changed accordingly.

It seems a reasonable deduction that, a determination of the nitrogen present in oil-shale, and calculation of the equivalent ammonium sulphate, would give the possible amount of ammonium sulphate obtainable from the shale; but in manufacturing, considerable losses occur: a large part of the nitrogen is evolved as uncombined nitrogen; a smaller amount as cyanogen; while the balance remains in the spent shale. The 'Henderson' retort yielded 16 to 20 pounds of ammonium sulphate from a shale containing nitrogen—equivalent to 74 pounds of ammonium sulphate per ton of shale; the 'Young and Beilby' retort, twice as much; while the 'Pumpherston' retort gave a still greater return—calculated at 52 pounds. It is evident that the Bailey method can only be applied to the process in which the 'Pumpherston' retort is used.

The possibility of extracting nitrogen in the form of ammonium sulphate by the Bailey method was tested as follows:—

A sample of oil-shale from Taylorville, Westmorland county, N.B., was carefully analysed, the results being:—

Volatile matter	37·46
Fixed carbon	4·34
Ash	58·20
Nitrogen	1·21
	100·00

By destructive distillation, and by Bailey's method, the following values were found:—

Crude oil	45·00 Imperial gallons per ton (2,240 lbs.).
Specific gravity of oil	0·905
Ammonium sulphate	89·3 lbs.
Nitrogen	0·85 per cent.

Nitrogen in the shale was determined by the Kjeldahl method, and the shale was found to contain 1·21 per cent of nitrogen—equivalent to 5·70 per cent, or 127·7 pounds of ammonium sulphate per ton of shale. The coke remaining in the tube was analysed by the same method, and showed 0·16 per cent of nitrogen—equivalent to 0·75 per cent, or 17 pounds of ammonium sulphate per ton of spent shale; which is a rather inconsiderable amount: only 0·10 per cent of nitrogen in the oil-shale; the spent shale containing 95·55 per cent of ash.

Thus, 70·2 per cent of the nitrogen in oil-shale can be obtained by the Bailey method, the loss being 29·8 per cent. Of this loss 8·2 parts remained in the spent shale; 21·6 parts being volatilized as uncombined nitrogen, and a smaller part as cyanogen.

The Bailey Method: 30 grammes of shale in small pieces are heated in a malleable iron tube, to bright redness, and subjected to a current of steam for one hour and a half; the resulting cases being led into a flask containing 2 N sulphuric acid. In this solution, ammonia is determined either by nitrometer or by redistilling with caustic soda.

The apparatus used consists of a malleable iron tube, ¾" inside diameter by 28" long; one end being closed by an iron cap—through which passes a brass tube; while the other end is connected with the steam supply. Pieces of previously ignited firebrick—about 5 millimetres in diameter—are dropped into the tube, so as to occupy about 8" of the tube next to the stop-cock. Then 30 grammes of shale—3 millimetres in diameter—are dropped into the tube, which is placed in the combustion furnace, with the portion containing the shale well in the centre of the furnace; so that it may readily be heated to a bright red. Into the open end of the tube next to the shale is fitted a cork, through which a brass delivery tube passes into a 600 c.c. flask, containing 50 c.c. of 2 N sulphuric acid. A second flask may be used to catch any ammonia that may be carried over. These flasks are immersed in ice water.

To start operations, the furnace is lighted, and the tube heated as rapidly as possible to bright redness: the time being noted when this is attained. It is essential that the time should not exceed 10 to 15 minutes. As soon as vapours begin to show in the glass tube, the stop-cock is opened and a moderate current of steam allowed to pass through the tube. The proportion of steam should be such that, after 1½ hours' heating to bright redness, about 400 c.c. of liquid are contained in the first flask. During operation the end of the iron tubes should be kept cold by wet lint or cloths wrapped around and kept moist in order to prevent charring the cork.

After 1½ hours, the apparatus is disconnected, care being taken that neither then nor at any time does any of the liquid go back into the tube, owing to reduction in pressure. The flasks are then rinsed out. To the liquid is added petrolic ether or other solvent for oil, thoroughly shaken, and the oil and liquid separated after standing for a few minutes. The liquid is made up to a volume of 500 c.c., or other convenient quantity, and then thoroughly mixed by shaking.

A measured portion of this liquid—say 250 c.c.—is evaporated in a porcelain dish on a water bath, until its volume is reduced to 5 or 6 cubic centimetres, and this residue is rinsed into the cup of a nitrometer, precaution being taken that all ammonia salts are transferred into the cup. Excess of sodium hypobromite is then added, the nitrometer is shaken, and the volume of nitrogen, temperature, and pressure is read off with all necessary corrections, from which data the total volume of nitrogen from 30 grammes of shale is calculated. One c.c. of nitrogen at N.T.P. is equivalent to 0·001562 grammes ammonia, from which the yield of ammonia sulphate per ton of shale may be readily calculated.

Sodium hypobromite is made by dissolving 5 c.c. bromine in 50 c.c. concentrated sodium hydrate solution. This solution is of such an unstable nature, however, that a fresh mixture has to be made for each determination.

Instead of using the nitrometer, a redistillation of the liquid with sodium hydrate may be made in the usual way; collecting the free ammonia in N sulphuric acid, and titrating the excess of acid with N alkali, using cochineal as indicator.

The assertion made by other chemists, that organic bases distil over with the ammonia, and hence render the resulting percentage of the latter too high, is not confirmed by the Mines Branch distillation tests; for this method was found to be quite accurate.

The following is a statement of Mines Branch analyses, compared with those made in the laboratory of the College of New York,[1] under the direction of Dr. Charles Baskerville:—

Number.	Sample from:	(Hamor.) Nitrometer Method. Am. Sulp. per ton.	(Leverin.) Distilling Method. Am. Sulp. per ton.
		Lbs.	Lbs.
1	Baizley's farm	110	112·2
2	E. Stephens	67	70
3	Adam's farm	93	96
4	Taylor's farm	110	104

Analyses of Oil-Shale.

(Leverin.)

Number.	Locality.	Crude Oil. Imper. gal. per ton.	Specific Gravity of Oil.	Ammon. Sulp. lbs. per ton.
1	Baizley's farm, Baltimore, Albert co., N.B.	52·0	0·904	112·2
2	Stephens, Albert co., N.B.	45·5	0·892	70·0
3	Turtle creek, Albert co., N.B.	56·8	0·891	30·5
4	Stellarton, Pictou co., N.B.	44·8	0·875	14·5
5	Albert mine, quarry I, Albert co., N.B.	22·2	0·892	28·0
6	Albert mine, quarry II, Albert co., N.B.	48·5	0·898	82·8
7	Albert No. 2, Albert co., N.B.	38·8	0·892	60·3
8	" " 3, " "	45·5	0·891	48·0
9	" " 4, " "	43·5	0·896	56·8
10	" " 6, " "	27·0	0·895	49·1
11	Albert mine (Albertite), Albert co., N.B.	112·0	0·857	93·5
12	Taylorville, Westmorland co., N.B.	42·3	0·897	96·5
13	" " "	47·3	0·901	88·7
14	" " "	46·8	0·902	85·0
15	" " "	45·0	0·903	104·0

[1] See Mines Branch Report on Oil-Shales, by Dr. R. W. Ells. Part I, p. 17, 1909.

APPENDIX III.

COPY OF REPORT ON THE PREVENTION OF MINE EXPLOSIONS: PREPARED BY THREE FOREIGN EXPERTS FOR THE UNITED STATES GEOLOGICAL SURVEY, AND PUBLISHED OCTOBER 22, 1908.

The report is addressed to the Secretary of the Interior, and with its recommendations is as follows:—

PREVENTION OF MINE EXPLOSIONS.

Foreign Experts make Report to Secretary of Interior.

WASHINGTON, D.C., October 22, 1908.

(Special.)—The Geological Survey issues to-day a report on the prevention of mine explosions, submitted by three foreign experts, Victor Watteyne, inspector-general of mines, Belgium; Carl Meissner, councillor for mines, Germany; and Arthur Desborough, H. M. inspector of explosives, England. These engineers have been in the United States for six weeks, coming at the invitation of the United States Government to assist the Federal authorities in beginning the investigations authorized at the last session of Congress. The report was presented to Secretary Garfield, who transmitted it yesterday to President Roosevelt, stating that the report with its recommendations will be of the highest importance in aiding Congress and the different state governments in providing legislation to ensure more efficient and careful operation of coal mines, by the adoption of mining methods and safety appliances that will materially aid in preventing such terrible losses of life as have occurred through mine explosions in recent years.

In view of the fact that this report is the first result of the Geological Survey's scientific and practical study of the conditions under which more than half a million miners work, the President ordered its immediate publication and distribution among the coal-mine operators and miners of the country. The report is addressed to the Secretary of the Interior, and with its recommendation is as follows:—

REPORT.

In response to your request that we co-operate with the United States Geological Survey in the inauguration of its investigations looking to the prevention of mine explosions, and that we submit for the consideration of those connected with the coal-mining industry in the United States such recommendations as experience in our own countries and observations among American coal mines indicates may be useful in providing for greater safety, we beg to submit the recommendations given below.

Since coming to the United States, we have given careful attention to and approve the investigations in relation to this subject begun by the Geological Survey. We have visited typical mines in the more important coal fields of the United States, and have discussed the mining problems with many coal operators, miners, and state inspectors.

To be effective, investigations for the benefit of mining must be continuous. The opening up of new mines, the deepening of old mines, the meeting with new condi-

tions, the changing of explosives, and the inauguration of new processes and methods will call for continuous investigations, to be followed by continuous educational work.

Our investigations and recommendations relate primarily to questions of safety in mining; but in this connection we have been greatly impressed with another closely associated phase of the industry, viz., the large and permanent loss of coal in mining operations in many portions of the United States. This is a serious, permanent, and national loss. It seems to be a natural outcome of the ease with which coal has been mined in the United States and the enormously rapid growth of the industry.

The active competition among the operators, and the constant resulting effort to produce cheaper coal, has often naturally led to the mining of only that part of the coal which could be brought to the surface most easily and cheaply, leaving underground, in such condition as to be permanently lost, a considerable percentage of the total possible product. Certainly much of this loss can be prevented through the introduction of more efficient mining methods, such as the long-wall system, more or less modified, the flushing method. (*See* 'H' 7.)

In the preparation of these recommendations we have recognized fully the great differences between the mining conditions in Europe and those in America, where the industry has developed so rapidly that thorough organization has not yet been possible; where a large percentage of the men entering the mine are unfamiliar either with mining methods or the English language; and where the price of coal at the mine is less than half that in Europe. Nevertheless, we believe that these recommendations will be found useful in the further development of the American coal-mining industry for safety and efficiency. The cordial reception everywhere accorded us leads us to believe that these recommendations will be received by the operators and miners in the same spirit of good will as that in which they have been prepared. But the success of this movement for greater safety and efficiency will depend upon the hearty and patient co-operation of the operators and the miners, working together for the accomplishment of this purpose.

RECOMMENDATIONS.

A.—Selecting the Explosives to be used.

(1) We recommend that the Government of the United States examine the explosives now and hereafter used in mining, with a view to eliminating the more dangerous explosives and to improving and standardizing such explosives as may be considered most suitable for such use, these to be designated by the government 'permissible explosives.'

The term 'permissible explosives' is suggested for the reason that no explosives are entirely safe, and all of them develop flame when ignited; and we advise therefore against the use in the United States of the terms 'safety explosives' or 'flameless explosives,' as these terms may be misunderstood and this misunderstanding may endanger life.

(2) We recommend that the operators and miners of coal use only such explosives as are included in a list of 'permissible explosives,' when the same has been published by the Government, in all mines where there is risk of igniting either dust or gas, selecting that one which their own experience indicates can be used to the best advantage under local conditions.

(3) We also recommend that investigations be conducted to determine the amount of charge of such 'permissible explosives' which may be used to the best advantage under different conditions with a view to reducing danger to the minimum.

B.—Carrying the Explosives into the Mines.

(1) All explosives should be made into cartridges and placed in closed receptacles before being carried into the mine, and the quantity carried into the mine during one day by any miner should be limited as nearly as practicable to the quantity needed by him for use during that day. Handling loose explosives and making them into cartridges by an open light in the mine should be prevented.

(2) Detonators or caps should be handled with great care, and should be carried only by a limited number of responsible persons.

C.—Use of Explosives in the Mine.

(1) Shooting in or off the solid should not be practiced.

(2) The depth of the shot hole should be less by at least 6 inches than the depth of the cutting or mining. The use of very deep shot holes should be avoided as unnecessarily dangerous.

(3) The overcharging of shots (the use of a larger charge than is required to do the work satisfactorily) should also be avoided as unnecessary and dangerous. The proper standardization of explosives used in coal mining will greatly facilitate the carrying out of this recommendation. (*See* also 'A' 1.)

(4) Shots should never be tamped with fine coal or material containing coal. Clay or other suitable material should be supplied and used for this purpose.

(5) The firing of two or more shots in one working place, except simultaneously by electricity, should not be allowed until a sufficient interval has elapsed between the firings to permit an examination of the working place, in order to see whether any cause of danger has arisen.

(6) Before a shot is fired the fine coal should be removed from the working place, as far as practicable, and the coal dust on the floor, sides, and roof, for a distance of at least 20 yards from the place where the shot is to be fired, should be thoroughly wet, unless it has been demonstrated that the dust in the mine is not inflammable. (*See* also 'E' 1.)

(7) If gas is known to occur in the mine, no shot should be fired until, in addition to the watering, an examination made immediately preceding the time for firing, by a competent person, using a lamp which will easily detect 2 per cent of gas, has shown the absence of that amount of gas from all spaces within 20 yards of the point where the shot is to be fired.

(8) Believing that such will be one of the greatest advances which can be made in safeguarding the lives of the miners, we recommend the adoption of a system of electric shot firing, in all mines where practicable, by which all shots in the mine, or in each ventilation district of the mine, may be fired simultaneously, at a time when all miners and other employes are out of the mine.

D.—Keeping the Mine Roadways clean.

(1) The roadways of the mines should be kept as free as possible from loose coal which may be ground into dust and of rubbish in which such dust may accumulate, in order to facilitate the removal and wetting of the dust.

E.—Wetting the Coal Dust.

(1) In all coal mines where explosives are used it is desirable, and in all mines containing gas it is highly important, that the dust on the walls, timbers and floors of the working places and roadways should be kept continually wet prior to and during the work in the mine. If, however, conditions of roof or lack of water render

this general watering impracticable, at least the dust within twenty yards of each shot should be wet before each firing, and other precautions against explosions should be practiced with unusual care.

It is our opinion that a system of watering which occasionally sprinkles the floor only and leaves dry the dust on the walls and timbers of the roadways is useless, and is also dangerous, in that it may generate an unwarranted feeling of security against an explosion.

F.—Special Precautions for Mines Containing Gas.

(1) In any mine where as much as 2 per cent of gas can be detected by suitable method, only locked safety lamps of an approved type should be used so long as such condition exists or is likely to recur.

All safety lamps should be maintained in good condition, cleaned, filled, kept in a special room at the surface, and carefully examined both when delivered to the miner and when returned by him at the close of each day's work. A defective safety lamp is especially dangerous because of the false feeling of security it engenders.

In the filling of lamps with benzine or other low-flash oils, which should always be done at the surface, special precautions against fire or explosions should be taken.

G.—Use of Electricity.

(1) Electricity in mining operations offers so many advantages, and has been so generally adopted, that no reasonable objection can be made to its use under proper restrictions. The electrical equipment, however, should be installed, maintained, and operated with great care, and so safeguarded as to minimize danger from fire or shock. The fact that the effectiveness of some insulating materials is soon destroyed in most mines should not be lost sight of.

We recommend the following precautions: For distribution underground the voltage should not exceed 650 direct current or 500 alternating current, these voltages being intended for transmission to machinery operating at 500 volts direct current and 440 volts alternating current, respectively. Even lower voltages are preferable. The trolley wires should be installed in such manner as to render shocks least likely; that is, placed either high enough to be beyond easy reach or at one side of the track and properly protected.

Where current at a potential of more than 650 volts is employed for transmission underground, it should be transmitted by means of a completely insulated cable; and where a lead or armoured covering is used, such covering should be grounded.

In all mines having electric installation special precautions should be taken against the setting on fire of coal or timber. Enclosed fuses or cutouts are recommended, and each branch heading should be so arranged that the current may be cut off when necessary.

No live electric wire should be permitted in that part of any mine in which gas is found to the amount of 2 per cent.

In all mines producing gas in dangerous quantities, as indicated by a safety lamp which will detect 2 per cent of gas, the working places should be examined for gas by a qualified man, using such a lamp, immediately before any electric machine is taken or operated there.

H.—Precautions against Miscellaneous Accidents.

(1) In all new construction, shaft lining and superstructures about the entrance of the shaft (or slopes or drifts) should be built as far as practicable of non-combustible materials.

About the entrances to mines every possible precaution should be taken to prevent fires or the injury of the equipment for ventilation and haulage. Ventilating fans should be placed at one side of the mine opening, and hinged doors or light timbering should render easy the escape of the explosive force in direct line of the shaft or slope.

Proper precautions should be taken for immediately preventing the entrance into the mine of heat and gases and for facilitating the escape of the men in case of surface or shaft fires.

(2) The surface equipment for handling the coal should be so arranged as to prevent coal dust from entering the mine shaft.

(3) In all new mines, and in all old mines as far as practicable, suitable main roads should be provided for the men separate from the main haulage roads.

(4) In connection with the system of ventilation it is recommended that in the more frequented roads connecting the intake with the return air courses, two doors be provided, these doors to be placed at such a distance apart that while one is open the other is closed.

(5) In view of the large number of accidents from falls of coal or roof, under the existing practice with single props, more attention should be given to the introduction in mines where the roof is bad of better systems of timbering, such as have been long in use with economy and safety in many well managed mines.

(6) In undercutting coal by hand, the premature fall of the coal should be prevented by sprags or other suitable supports.

(7) We believe that the difficulties and dangers encountered in the working of coal seams which are thick and steeply pitching, or of which the coal is highly inflammable in character or subject to firing from spontaneous combustion, and in mines where the subsidence of the surface must be avoided, may be successfully and economically overcome in many cases through the adoption of the flushing system of mining—that is, the filling with sand or other similar materials of the space from which the coal is removed. This system originated in the United States and is now successfully practiced in portions of Germany, Austria, Belgium, and France.

I.—Mine Supervision and Inspection.

(1) We cannot too strongly emphasize the fact that thorough descipline about the mine is absolutely essential to safety, and that thorough descipline can be brought about only through the hearty co-operation of the operators, the miners, and the State.

(2) We are of the opinion that the reponsibility for safety in the mine should primarily rest with some person, such as the manager or superintendent, clothed with full authority; and that such person can greatly facilitate the attainment of safety through the employment of a sufficient number of foremen, and also of one or more inspectors whose special duty it shall be to see that the regulations are strictly enforced.

(3) The State cannot exercise too much care concerning the experience, technical training, and selection of its inspectors. Their positions should be made independent of all considerations other than that of efficiency; and their continuance in the service should be co-existent with good behaviour and proper discharge of official duty.

J.—Training for Mine Firemen, Inspectors, etc.

We are of the opinion that the cause of both safety and efficiency in coal-mining in the United States would be greatly aided through the establishment and maintenance in the different coal regions of special schools for the training of fire bosses,

mine foreman, superintendents, and inspectors. The instruction in such schools should be practical rather than theoretical.

The work of these schools would supplement most effectively that of the colleges already established in many parts of the country for the more thorough training of mining engineers.

APPENDIX IV.

ON THE EXAMINATION OF MAGNETIC ORE DEPOSITS.

Howells Fréchette, M. Sc.

In the examination of magnetic ore deposits much useful information may be gained by an investigation of the strength and direction of the magnetic force exerted by the ore at various points in its neighbourhood.

These ore bodies may be considered as huge magnets penetrating the earth's surface, having all the properties of magnets as we know them. In the northern hemisphere the upper portion of the ore body is of north polarity and the lower portion is of south polarity. This arrangement is due to the magnetism being induced by the magnetic lines of force of the earth.

The following is a brief statement of the method of observation used by the Mines Branch of the Department of Mines, and the method of interpretation, leaving aside the more technical calculations and the theory on which the methods are based.

The instrument employed to make the necessary magnetic measurements is the Thalen-Tiberg magnetometer. It consists of a compass mounted on a brass support in such a way as to permit the compass-box to rest either in a horizontal or a vertical plane. To the brass support is attached a horizontal arm about 10 inches long, having a movable carriage to which may be fixed a small magnet. The compass needle is pivoted so that it is free to swing when the box is either horizontal or vertical. The instrument is supplied with level bubbles, leveling screws, lining sights, adjusting screws, etc., and is mounted on a tripod.

ADJUSTMENT OF THE MAGNETOMETER.

Although the magnetometer is tested and adjusted by the instrument maker before leaving his shop, it is advisable for the observer to satisfy himself as to the adjustments before using it. The necessary adjustments are fully described on page 29 in Dr. Eugene Haanel's book on the 'Location and Examination of Magnetic Ore Deposits by Magnetometric Measurements.'[1] There are, however, two adjustments given below which must invariably be made in the vicinity of the ore body, but not near enough to be within the reach of its magnetic influence.

The magnetometer is set up in a normal field, that is, at a point free from local magnetic disturbance. With the compass box horizontal, the instrument is rotated on its vertical axis until the needle points to 90°, that is, at right angles to the axis on which the compass box swings. The compass box is now tipped into the vertical plane. The needle should read zero, that is, it should swing into a horizontal position; if not, the small weight on the needle must be moved along until the needle registers zero. The weight is then clamped.

The compass box is again tipped into the horizontal plane and the needle swings back to 90°. The needle is now at right angles to the arm of the brass support. The small deflecting magnet is then placed on the carriage of the arm, parallel to the arm. This causes the needle to swing away from its original position. The carriage is now moved along the arm until the needle reads, say 60° on the scale, and then clamped. In other words, with the present setting of the deflecting magnet, the

[1] Issued by the Mines Branch, Department of Mines.

deflextion of the needle is 30°. Certain conditions may demand a different setting of the magnet, which, of course, would change the amount of deflexion when set up in a normal field, but 30° is found in most cases to be satisfactory.

After thus preparing the instrument, it is ready to be used for the measurement of the vertical and horizontal intensity of the magnetism in a disturbed field, that is, where the influence of the magnetic ore body is felt.

The lines of force of the magnetic ore body radiate in all directions, therefore, for convenience of observation and calculations, the force at any point is resolved into two component forces at right angles to each other, the vertical force and the horizontal force.

The magnetometer is set over the point of observation with the compass box horizontal, the needle brought to 90° by rotating the instrument on its vertical axis. The instrument is then clamped, the compass box tipped into the vertical plane, and the needle read. Should the north seeking end of the needle point down, we have a reading of positive vertical intensity; if up, a reading of negative vertical intensity, which is recorded by prefixing the minus sign.

The compass box is tipped back to the horizontal position, and the needle again reads 90°. The deflecting magnet is now placed on the carriage and the needle read. The deflected angle is noted. Care must be taken not to have any magnetic substances near the instrument that would affect the readings.

EXAMINATION OF A MAGNETIC ORE DEPOSIT.

The area of ground under examination should first be gone over thoroughly with some form of dip needle and the points of maximum dip marked. The Swedish Mining Compass is the best instrument for this purpose as the needle of it is so suspended that it is free to range itself along the local magnetic meridian, and also free to dip. A line joining the points of greatest dip gives the general direction of the strike of the ore field.

A base-line is now run through one of these points, parallel to the strike, stakes being driven at regular intervals, 30 feet for convenience. From these stakes, and at right angles to the base-line, subsidiary lines are run to the limit of the disturbed field. These lines are also staked every 30 feet. In this manner the whole area to be investigated is laid out in squares.

For the purpose of identifying any stake in the field, the rows of stakes parallel to the base-line are marked with letters, those at right angles to it with numerals; thus on each stake is marked the letter and number of the respective rows to which it belongs.

Readings of the vertical and horizontal intensity should be taken at each stake.

MAPS.

If the vertical and horizontal intensities have both been determined, it will be necessary to make two maps.

Where the interval between stakes has been made 30 feet, it will be convenient to plot our maps on the scale of 60 feet to one inch. The paper is cross-ruled at ½″ intervals, thus representing the lines laid out on the ground.

Map of Vertical Intensity.

The vertical intensity of each stake, as represented by the degrees read on the compass scale when in the vertical plane, is marked at the intersection of the corresponding lines of the map. When all the readings have been marked on the map, lines, known as the isodynamic lines, are drawn through points of equal intensity. The method of drawing these lines is similar to that used in drawing con-

tours of elevation. They are drawn at intervals of 10°, through the zero points and through every 10th degree higher and lower than zero. It is usual to colour the map; the positive areas blue and the negative areas yellow. Between 0° and 10°, and 0° and — 10°, one wash is used, between 10° and 20° and — 10° and — 20° two washes, and so on, thus giving deeper shades for the high positive and high negative areas.

Map of Horizontal Intensity.

A map of the horizontal intensity is prepared in a similar manner. In this case, however, the isodynamic lines are drawn at intervals of 5° instead of 10°. Having taken 30° as our deflexion angle in a normal field, we must adopt 30° as our neutral line. Areas of intensity above 30° are coloured green, and below 30° pink. Thus we have the areas between 30° and 35° with one wash of green, between 35° and 40° two washes of green, between 30° and 25° one wash of pink, between 25° and 20° two washes of pink, and so on.

Besides the magnetometric readings, the maps should show outcrops, ore and rock piles, shafts, pits, buildings, roads, streams, etc.

INTERPRETATION OF MAGNETOMETRIC MAPS.

Map of Vertical Intensity.

In interpreting our maps, we must recognize the fact that the contour of the ground over which the observations were made has a marked effect on the shape of the isodynamic curves; therefore, let us first consider the ideal case, that in which the land is perfectly level.

From the map of vertical intensity we gain the most information. In general, the highest positive readings of vertical intensity are found to be over the upper pole of the ore body. Long narrow curves of somewhat regular, elliptical shape indicate an ore body regular in form.

The strike of the ore body is along the direction of the longest axis of the curves of maximum intensity. Irregularities in these curves are occasioned by irregularities of the ore mass, by neighbouring ore bodies, or by the presence of some distributing magnetic influence, such as from an ore pile, rock pile containing ore, or from iron or steel in structures or machinery.

The dip of the ore body is indicated by the relative spacing of the curves on either side of the area of maximum intensity. If the distances between the curves are greater on one side than on the other, the body dips towards the side where the curves are nearest together, that is where the magnetic intensity decreases most rapidly.

The action of the lower pole of the ore body comes into evidence in the production of a negative area, which occurs with every magnetic ore deposit and which surrounds the area of positive intensity. If the ore body extends vertically to a great depth, the attraction of the lower pole is correspondingly feeble, but increases in intensity as the dip of the ore body decreases and the lower pole approaches the surface.

In determining the size and shape of the ore body, very close attention must be paid to all outcrops of the ore and their positions compared to the isodynamic curves. The higher curves of positive intensity will generally represent the approximate shape of the ore body.

The above applies to distinct bodies of ore not having great thickness of cover over them, but should the ore body be deeply covered we can determine its position but cannot arrive at any close conclusions regarding its size or shape. The maximum intensity in this case will, of course, be much lower than where the ore reaches to the surface.

Where we have to deal with an uneven low grade, or disseminated ore each case becomes a special problem to be worked out by careful reasoning and comparison with somewhat similar occurrences.

So far we have only considered deposits situated where the ground is level. This is seldom met with in practice, therefore we must note the effect of taking our observations at different altitudes, such as would be done where we have cliffs or hilly ground. We will consider an extreme case. Suppose a body outcrops at or near the top of a cliff. We will get a strong positive reading at the top of the cliff, and at the foot a strong negative. In both cases it is the upper or north pole of the ore body that exerts the greatest influence on the magnetometer needle. In the first instance the pole is below the level of the instrument, and will draw the north-seeking end of the needle down, giving the positive reading; in the second the pole is above the level of the instrument, drawing the north-seeking end up, giving the negative reading.

Readings taken down a hill side on which the ore outcrops, will decrease more rapidly than would readings taken at corresponding distances from the same ore body, were the terrane level.

It is important to keep these facts in mind when interpreting magnetometric maps, therefore notes as to the slope of the ground should be made, or better, a contour map of the ground prepared on the same scale on tracing paper to be laid over the magnetometric map. The contours might be plotted on the same map, but this would probably cause a confusion of lines.

Map of Horizontal Intensity.

From this map we learn little else than the location of the upper pole of the ore body.

Where we are dealing with a single ore body of regular form, if we draw a line through the maximum point and the minimum point of horizontal intensity the point of intersection of this line with the neutral line indicates the position of the upper pole of the ore body. If, however, we are dealing with a group of ore bodies or a body of irregular shape, the map becomes complex and definite information cannot be obtained from it.

DEPTH BELOW SURFACE, ETC.

Should the ore body not outcrop we may determine the thickness of covering over it. We can, also, where conditions are favourable, determine the depth to which the body extends.

The methods involved in determining these quantities are somewhat complex and do not come within the scope of this article. For these methods reference must be made to Dr. Haanel's book, already referred to, which is the only exhaustive treatise on the subject in English.

It is to this volume that I am indebted for the information conveyed in this article.

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